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CONTENTS

FEBRUARY, 1940

A McGRAW-HILL PUBLICATION

Clashing Philosophies of Government and Trade..... *Editorial Foreword*..... 61

Chem. & Met. Report No. 2—Chemical Raw Materials..... *Editorial Staff*..... 63–94
Annual review section. Thirty-two page report (with illustrations in color) prepared by the *Chem. & Met.* staff to give the latest economic information on chemical commodities. For table of contents, see p. 68.

New Products From Wood..... *James A. Lee*..... 95
Masonite Corp., Laurel, Miss., is developing a new line of chemicals including activated carbon, and many new types of boards from exploded wood chips.

Advances in Menhaden Reduction..... *J. Howard Smith*..... 99
Greater yields, an improved product and proper waste disposal in the menhaden oil industry resulted from new centrifugal processing at East Coast fish reduction plants.

Design for Distilled Water..... *Auburn A. Ross*..... 100
Utmost care is exercised in providing supply of distilled water for Eli Lilly's new plant. A novel design, with a view to the future, and aluminum alloy construction are important features.

Granulating Phosphate Fertilizers..... *J. N. Mackall and Mark Shoeld*.... 102
Continuing our January story of operations at Davison Chemical Co., Curtis Bay, Md., this article gives a description of process and equipment developed for granulating superphosphates and mixed fertilizers.

Paint Baking With Near Infra-Red..... *H. J. Bennett and H. Haynes*..... 106
Because incandescent lamps radiate about 90 per cent of their input energy, they may be used to advantage in the drying of lacquers and enamels.

New Plant for Church & Dwight at Syracuse..... *Editorial Staff*..... 109
Story of the new windowless, modernistic, air-conditioned plant for the refining of bicarbonate of soda at Syracuse, N. Y., is told pictorially.

How to Select the Container..... *R. W. Lahey*..... 110
Proper design of packages and shipping containers is the key to elimination of loss and damage to materials in transit.

Modern Sugar Refining..... *A Chem. & Met. Pictured Flowsheet* 119
Sucrest Corp., Brooklyn, N. Y., has developed and adapted a new process for refining cane sugar in which neither bone char nor activated carbon is used. The story is told in pictures.

Editorial Supplement.....**A Decade of Chemical Progress**.....**3 page Wall Chart**

SEVENTEENTH ANNUAL REVIEW NUMBER

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Cane sugar refinery put in operation in 1936 at Brooklyn, N. Y., by the Sucrest Corp. Their process uses no bone char or activated carbon, and all usual filtrations have been reduced to a single polishing filtration. The system has been reduced to a minimum of operations with considerable economy. Other pictures will be found in the Pictured Flowsheet on pp. 119-122.

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CHEMICAL & METALLURGICAL ENGINEERING
ESTABLISHED 1902

FEBRUARY, 1940

S. D. KIRKPATRICK, *Editor*

Clashing Philosophies of Government and Trade

ONE SCHOOL OF THOUGHT, to which most of us in chemical industry have subscribed, is that industrial self-sufficiency is a vitally important national asset. We have seen the unfortunate effects of utter dependency on foreign sources for basic organic chemicals and medicinals. But in the last twenty years, we have also witnessed the creation and development of a remarkable industry, largely as the result of tariff protection. Some of us have held that by thus providing our country with nearly all the essential commodities of commerce, we have greatly strengthened the cause for peace.

This contention is strongly opposed by a second and very vocal group of our citizens. They call us blind isolationists. They claim that our tariff policies are directly responsible for the present European war—that the Fordney-McCumber and Hawley-Smoot Acts started a wave of economic retaliations and reprisals that spread throughout the entire world. If that be true, the world has gone far ahead of the teacher in setting up trade barriers—ranging all the way from dictated quota systems and preferential treatments to absolute embargoes. Each nation makes its decision regarding trade which its governing unit thinks desirable from its own political point of view. Even in the United States, the making of tariff decisions is a political, not an economic action. Social considerations determine the decisions; but the effects are economic.

These clashing philosophies of governmental attitude toward international trade are now being aired in the congressional hearings on the bill to extend the Trade Agreement Act, which otherwise expires on June 12, 1940. Whether Secretary Hull shall have the authority to continue negotiation of trade agreements by the cutting of tariff rates is a matter of basic importance to agriculture, mining, forestry and manufacture.

The extent to which chemical industry is involved in this debate can be shown by a few significant figures. About one-fourth (23 per cent) of all imports of "Chemicals, Oils and Paints" have been subject to reduced rates as a result of the 24 trade agreements, made since 1934. The equivalent ad valorem rates on these imports were reduced almost a third (31 per cent) or from an average of 32 to 22 per cent. Most drastic reductions (averaging approximately 50 per cent) were on distilled spirits, paper, sugar and acetic acid, although coal-tar dyes and other synthetic organic chemicals have suffered almost as much. For good reason, therefore, the Synthetic Organic Chemical Manufacturers' Association of the United States has filed a vigorous brief with Chairman Doughton of the House Ways and Means Committee, urging that no further reductions be made without Senate ratification and that reductions already effected should be

subjected to study under the flexible tariff provisions of the Act of 1930. The Association points out quite aptly that flexibility is more needed now than ever before in order to meet quickly the changing conditions of world trade.

Most of the forthcoming debate and discussion in Washington on tariff and trade agreements will probably center around arguments over the basic philosophies of nationalism and internationalism. But from the practical viewpoint of chemical industry, it seems to us that two very practical questions are involved: (1) Should the United States continue its traditional tariff policies and procedures, or should it use the tariff as a means of enlarging its foreign trade even in the fact of the dictatorial systems of trade regulation which prevail in other important industrial countries? (2) For such changes in tariff rates as may be required for the good of America and/or the world, shall the decision be made by Congress (admittedly with political log-rolling) or by a single cabinet member (the Secretary of State) or is there some quasi-judicial system of scientific tariff-making that can be made as workable as it is desirable?

It is not in the province of chemical industry or the chemical engineering profession to answer these questions to everybody's satisfaction. Each of us can, however, analyze them with intellectual honesty. We can discuss them among ourselves and with our official representatives in Washington. We can apply a little intelligence and constructive thinking as at least a partial corrective for the partisan politics that must ultimately decide these basic economic and social questions.

RECOGNITION AND AWARD

ON FEBRUARY 27, in connection with the 150th anniversary of the American patent system, nineteen national awards will be presented by the National Association of Manufacturers to "Modern Pioneers on the Frontiers of Industry." The recipients will be research scientists, engineers and executives whose achievements have resulted in the creation of new industries and new jobs. Prior to that time, local dinners will honor several hundred other leaders in technology. A goodly representation of the chemical and engineering professions will certainly be found in both groups. We look forward with keen interest to the decisions of the Award Committee of six eminent scientists, headed by Dr. Karl T. Compton of M.I.T. Here will be an excellent opportunity to present convincing proof that the public good has been generously served as the American patent system has stimulated private enterprise through the disclosure and application of scientific advances and inventions.

WAR CASUALTY?

FOR THE FIRST TIME in many years our annual review and statistical number appears this month without the valuable statistics on the world nitrogen industry which are compiled and made available each year by the British Sulphate of Ammonia Federation, Ltd. All on the Federation's mailing list, with the exception of its members, have received courteous notes expressing with regret the organization's inability to continue the usual statistical surveys but promising prompt cooperation as soon as such international activities can be resumed. Here then is another reason why we can wish for prompt and permanent peace "over there."

PATENTS AND FERTILIZERS

MODERN FERTILIZER PRACTICE has been improved by chemical engineering developments that have been all too little noted throughout the process industries. Conversely, an article in this issue spotlights one important factor too often overlooked in the fertilizer business itself, namely the sort of research which may lead to patented processes and products. Too little money has been spent on new developments of a fundamental nature by the fertilizer industry. Despite the fact that it is one of the largest among the chemical process industries, its research spendings have been almost negligible.

Very little advantage has been taken of the fact that new things which are really good can be patented and therefore protected for the profit of the sponsoring company. Without that sort of protection it is doubtful whether any management in this highly competitive division of industry can afford to go ahead and spend hundreds of thousands of dollars on new and promising methods or invest the necessarily larger sums for plants and equipment.

Chemical engineering has contributed very greatly to the production of cheaper fertilizer chemicals. It can contribute more. Research to that end deserves support of individual companies and of the industry as a whole.

MOBILIZING TRAFFIC PLANS

THE RAILROADS of the country must be the backbone of either peace-time or emergency transportation. Rail executives have, therefore, been restudying the lessons of the World War and trying to figure out what they will do if another emergency should threaten burdensome congestion. They have reached some conclusions which are quite significant from the standpoint of the traffic plans of process industries.

Perhaps most important of all these relates to the limitation on loading of freight cars. It is proposed that an empty car will not be furnished to any user until it is demonstrated that the car can be unloaded promptly at the destination, if shipped. Recalling the extensive use of cars for storage purposes, and the delays in unloading at seaport destinations, they are rightly contemplating some such regulation.

Process industries must take account of this situation. They must understand that a board in Washington may be very hardboiled on car assignments, restricting car usage for any one of several reasons. Planning for proper transport of goods in and out of works must, therefore, take account of these potential difficulties. At the outset, the regulatory scheme will be new and cumbersome. It may be even more restrictive than would be a serious congestion on the rails.

All this means more need for reserve stocks of raw material and for ample space to store goods in process and goods ready for shipment. The chemical engineer of each unit of process industry might as well face this fact and do a little planning on his own, *now*.

SERIES B • NUMBER 2

CHEM. & MET. REPORT ON

CHEMICAL RAW MATERIALS

TO

CHEMICAL EXECUTIVES AND CHEMICAL ENGINEERS

WHAT IS HAPPENING today in Europe brings into bold relief an ever-present problem of the process industries. Nations, deprived of vital raw materials, will first seek substitutes—then, in desperation, seize neighboring resources through the age-old formula of aggression. Industries, even in times of peace, fight for their supplies of essential raw materials. Competition between commodities becomes especially keen as new and unusual factors affect the markets for materials, disturb the normal channels of trade, unbalance the established price structures for goods and services. War is such a factor and even though we sit on the sidelines we cannot escape its influence.

Because these raw material problems are pressing for immediate attention by all who are concerned with production in the chemical process industries, this 17th Annual Review and Statistical Section of *Chemical & Metallurgical Engineering* is presented as a factual report to chemical executives. In it the editors have attempted to evaluate the major factors, national and international, that affect the commodity situation in the United States today. Its facts and figures are presented not so much as a review of what happened last year but as a working basis for projecting plans and production programs for future plant operations.

TITLE OF REPORT Chemical Raw Materials

TO Chemical Executives and Chemical Engineers

FROM Editors of Chem. & Met.

DATE February 1940

INTRODUCTION

EVERY CHEMICAL EXECUTIVE, every chemical engineer concerned with production or distribution, faces a variety of problems having to do with basic chemical raw materials. He asks himself such questions as these: What is my assurance of continued and adequate supplies? What is likely to happen to prices, especially if and when war demands come in earnest? What should be my company's policies on inventories in times like these? Isn't it time to investigate or re-appraise the value of substitutes and competitive materials and processes? What factors are going to affect costs most in 1940? Labor? Transportation? Taxes and regulatory agencies? What about exports and new domestic markets arising from overseas disturbances?

This report has been prepared primarily to help *Chem. & Met.* readers in reaching the right solutions to these very problems. There immediately follows a brief synopsis of important recommendations that are based on the more general considerations outlined in the three succeeding pages. Next come the critical commodity reviews citing in text, tables and charts the detailed figures that must be studied intently because there are essential differences in each commodity situation. The plan, therefore, is first to outline the need for broad review and careful planning and then to supply the specific data that are necessary to carry such plans to completion.

SYNOPSIS

1. In contrast with most other countries, the United States has (with a few exceptions) sufficient mineral and agricultural resources to take care of practically any normal demands for chemical production. However, these are not normal times. Some potential supplies are undeveloped; others are of marginal quality or can be obtained only at higher costs. Hence present and future sources must be carefully studied not alone as to availability in emergency, but also as to quality and prices. If you use any strategic or critical materials of foreign origin, make doubly sure that you will not be deprived of necessary supplies.

2. Because of advances in modern technology, today few if any chemicals are absolutely irreplaceable. Competition between commodities or between alternative manufacturing processes varies with changing economic conditions. You will do well to investigate substitutes for as many as possible of your basic raw materials. Also determine the present feasibility of competing processes and types of equipment required.

3. So far, most chemical raw material prices have not risen markedly, although any active bidding on the part of the belligerents would likely be reflected quite promptly. In the meantime, executives in the process industries are well advised in their efforts to maintain stable prices. If they fail, the government is ready to step in. Raw material purchases withheld too long because of current weakening in commodity prices may result in quick upturn this Spring, especially if more intensive hostilities bring on a new wave of war orders. War is inevitably an inflational influence on prices. (See chart on following page.)

4. Conservative inventory policy right now calls for slightly unconservative action. More liberal supplies of raw materials must be kept on hand than has been the case during the past few years. To drop again to the inventory levels of last Summer would be extremely dangerous—especially if supply might be threatened by labor, transportation or war disturbances. Those industries now operating at high levels will do well to replenish the supplies as used in order that adequate stocks can be maintained at all times.

5. Possibilities for expanding markets, both domestic and foreign, now warrant increased attention by chemical executives. Profitable business can often be handled without over-expansion of manufacturing or distribution facilities. Market research and sales development work are needed more than ever in a period where mistakes may be both frequent and costly.

6. Inter-relationship of so many other influences affect chemical costs that the manufacturer is well advised to review his cost finding methods, to make certain that the relative importance and weighting of all factors are definitely known and appreciated. Changes in the costs of materials, labor, transportation or taxes may or may not be offset by market fluctuations. This is no time for guesswork by the accounting department.

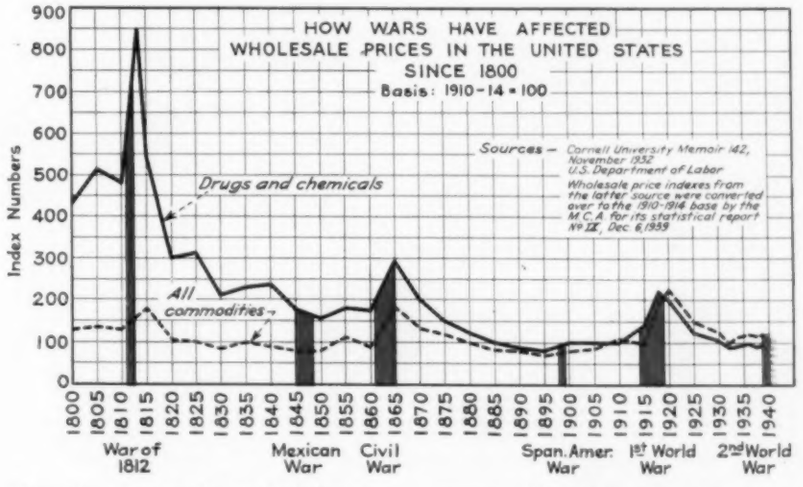
THE UNITED STATES is more nearly self-sufficient than any other nation in the world. Our agricultural and mineral raw material resources are an unparalleled national asset. Our chemical and process industries, built on such a firm foundation, have as yet suffered very little as a result of the present European conflicts. Those few that are dependent upon supplies normally brought from abroad have not been seriously inconvenienced, but it is evident that as our government, as well as those of foreign countries, continue large-scale purchases of so-called "strategic" and "critical" commodities, we may expect shortages and market stringencies. Rubber, of which this country uses about a billion pounds each year, is the best known example of a strategic material. Chromium, ferro-manganese, mercury, nickel and tungsten are others. Every chemical manufacturer should be familiar with these lists. (For definition and complete lists, see *Chem. & Met.* Dec. 1939, pp. 754–6).

These lists would be very much longer were it not for the fact that within the past twenty years, the chemical process industries have prepared themselves to take care of most American needs, either in peace or war time, without the aid of imports. That effort has not come from any isolationist policy, seeking blindly for national self-sufficiency. Rather it has been the result of creative research and engineering development directed toward lower costs and a more profitable economy. That, rather than artificial subsidy, should be the basis on which our future supplies must be developed—whether from synthetic sources or as a result of improved technology of extraction and utilization.

No Monopolies

In most areas of chemical activity effective monopoly is impossible. To be sure, a single company may control the output of one chemical—in fact it often does—but that is not effective monopoly. It does not preclude the possibility of substituting a substantially equivalent commodity. It does not stop that kind of competition between commodities and between alternative processes which is so prevalent in chemical industries. A half dozen rubber substitutes are available for specialized applications. Plastics are tailored chemically to fit the patterns of a multitude of requirements.

Recently a group of well-informed chemists and engineers were gathered for an informal session. Someone asked this group of about twenty men to name one single irreplaceable chemical which is of industrial importance in the United States. The group tried valiantly. It did not succeed in naming any commodity for which modern research and technology could not devise a satisfactory substitute for many, if not most, of its present applications. Chemical engineers have long recognized these facts, for they are part of any sound study of product and process feasibility. In times like these when established supplies and price relations may be drastically affected, every chemical manufacturer can well afford to investigate and re-appraise the commercial possibilities of substitute raw materials or processes.


HOW WARS HAVE AFFECTED
WHOLESALE PRICES IN THE UNITED STATES
SINCE 1800
Basis: 1910-14 = 100
Sources – Cornell University Memoir 142, November 1932
U.S. Department of Labor
Wholesale price indexes from the latter source were converted over to the 1910-1914 base by the M.C.A. for its statistical report No. IX, Dec. 6, 1939
Drugs and chemicals
All commodities
Index Numbers
War of 1812
Mexican War
Civil War
Span.-Amer. War
1st World War
2nd World War

Note the price peaks reached during previous periods of national emergency. Chemical prices have been lower after each succeeding peak.

What About Prices?

The long-term price trend for chemicals has been downward for almost twenty years, largely as a result of developments within the industry—new processes, new products, improved technology, more efficient management. Last September that downward trend was at least temporarily reversed following the outbreak of the war in Europe. The upward price movement, as far as chemicals are concerned, has not been drastic—in fact there have already been a few minor recessions; but the conditions which brought about the reversal are still in effect. Any consideration of prices over a long period must be faced on these exist-

Factors Favoring Higher Prices

1. Higher production costs are resulting from rising costs for raw materials, transportation, taxes, labor, etc.
2. Increase of export orders, not only for chemicals but for goods in which chemicals are used.
3. Spot and export sales are being made generally at higher than contract prices.
4. Scarcity of spot stocks for immediate delivery.
5. War demands resulting from increased intensity of activities.
6. Experience in case of previous wars (See Chart).

Factors Favoring Stable or Lower Prices

1. Continued improvements in technology and the use of substitute commodities tend to offset advancing costs.
2. Policy of reserving production for domestic requirements without seeking export accounts.
3. Many 1940 contracts were renewed at prices unchanged from those of 1939.
4. More liberal policy on inventories in hands of consumers.
5. Conservative attitude of most chemical producers toward "war business."

ing conditions. First is the uncertainty as to the duration of the war. The defeat of Germany or of the Allies within a relatively short time seems scarcely tenable. Without complete capitulation, peace proposals are equally hopeless. Therefore any forecast of prices must rest on the assumption that the war will continue.

On this premise we may line up the influences which favor higher prices and balance them against those which may stabilize or revive the downward trend. (See table on p. 65.)

Most of these factors are self-explanatory and subject to fairly definite evaluation. More difficult to appraise, but nevertheless quite important, is the attitude of the domestic producers. It is a matter of record that most of them have attempted to supply their regular customers at the old prices. They have refused to take export business except where there were surplus stocks. They have confined transactions to direct dealings between producer and consumer, thereby reducing speculative trading to a minimum. Had they not followed this course, prices of chemicals might have soared to the levels reached in the first World War.

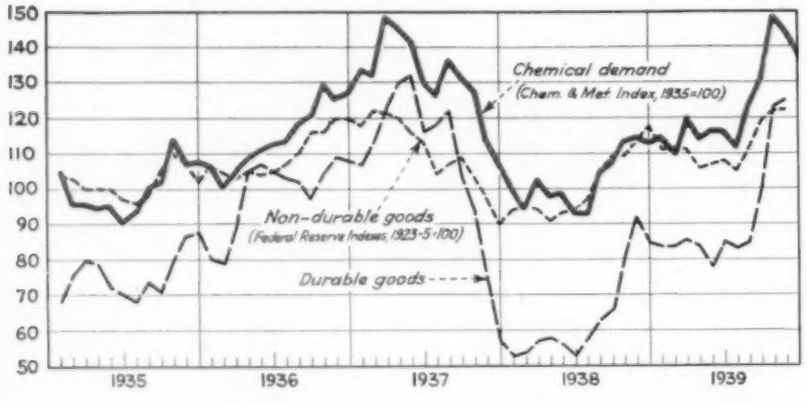
Conclusion: The weight of evidence is on the side of higher prices but the desire of producers to hold advances in check and to control supplies in the hands of non-users is a guarantee against a runaway market just as long as the producers maintain that attitude toward their business.

What about Inventories?

Apparently what the country needs most is a good, accurate measure of stocks of goods held by both producers and consumers. The problem is especially acute in chemical industries where even the current production statistics are not available for most commodities. It is general knowledge, however, that inventories were extremely low last summer and that one of the first consequences of the war abroad was a wave of buying in this country—partly to restock depleted inventories. This process of restocking greatly stimulated many lines of business and relatively high levels of industrial activity were maintained rather generally during the last quarter of 1939. As goods were used, most plants replenished their stocks in order to make sure that they would not be caught short in the event of a sudden rise in business activity.

Since the first of the year there has been a more cautious attitude toward business expansion but the National Association of Purchasing Agents, in its most recent bulletin, (Jan. 31, 1940) reports an entire absence of any apprehension about the situation during the next few months. It states that while inventories "are apt to show some reduction during the next couple of months, it is more than likely that more liberal supplies of materials will be kept on hand than was the case during the past few years. . . . . With inventories on hand far from burdensome and the immediate future uncertain, most buyers are following a conservative policy and watching developments." Under such circumstances each man will write his own definition of "conservative policy". It may well be conservative to be slightly unconservative in carrying considerably more goods in inventory than would be the case under more normal conditions.

The National Industrial Conference Board reports that the value of inventories at the end of December, based on reports of about five hundred representative companies, was 3.3 per cent greater than a month earlier, which compared with an increase of 5.3 per cent from October to November. Since the end of August, inventories increased 13 per cent, to stand at the highest level since March, 1938. Most recent data from the Conference Board appear in the following table.



Chemical consumption more closely approximates the trend in the production of non-durable goods than that for the heavy industries

BUSINESS WEEK'S WEEKLY
150
140
130
120
110
100
90
80
70
60
50
40
1923-25=100
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1929
1930
1931
1932
1933
19

National Industrial Conference Board Indexes of Value of Manufacturers' Inventories, New Orders and Shipments

1936 = 100 (Seasonally Adjusted)

Period		Inventories (end of period)	New Orders	Shipments
(Annual)	1929	127	134	134
	1930	125	99	105
	1931	100	66	71
	1932	78	41	46
	1933	70	47	51
	1934	87	61	65
	1935	90	74	79
	1936	100	100	100
	1937	133	100	118
	1938	118	79	85
(Monthly)	1939			
	January	113	93	97
	February	112	88	97
	March	112	87	97
	April	111	84	87
	May	111	90	92
	June	110	86	94
	July	111	90	91
	August	110	93	100
	September	111	164	111
	October	114	148	115
	November	120 r	128 r	124 r
	December	124 p	113 p	128 p

r Revised. p Preliminary.

Expanding Markets

Much has been written about the results of research in the chemical industries and the consequent flow of new products. From a market standpoint, corresponding importance must be given to the expanding outlets for chemicals afforded by the development of new products within the consuming industries. New synthetic fibers, glass blocks for buildings, glass wool for insulation, new types of lacquers and finishes, solvent extraction and other chemical processes for petroleum refining, new detergents, new plastics, widening of kraft pulp and paper production through improved bleaching processes—these are typical developments which explain why the market for chemicals is expanding more rapidly than the natural growth in population and industry.

In 1939, consumption of chemicals was the second largest in the history of the industry and for some branches new records were made both for production and consumption. Considering the moderate position of general industry for the first half of last year, it is evident that second-half operations must have been at an unusually high rate. With some moderation in activities, the new year opened with prospects far more favorable than those which existed at the beginning of 1939. Producers of rayon yarn made a new record last year even though some of present capacity was not in existence until the latter part of the year. Furthermore stocks of yarn on hand at the end of the year were very small as contrasted with stocks of 39,500,000 lb. at the beginning of the year. Automotive and building estimates generally forecast a rise in these industries for the present year. Agricultural and insecticide chemicals are expected to benefit from the rise in prices for farm products.

Recently published estimates by the Shippers Advisory Boards of the United States forecast a 10.4 per cent increase in the railroad shipments of chemicals and explosives for the first quarter of 1940 as compared with the same period of 1939.

In addition to the improvement in position of consuming industries at the beginning of this year in comparison with twelve months ago, demand for chemicals will be stimulated by increased buying for export. If the figures for exports of chemicals in the final months of last year may be taken as a criterion, the volume of export shipments this year will be large enough to warrant some expansion in current plant capacities especially when it is considered that shipments in recent months have been restricted partly because production was reserved for domestic buyers with little or no surplus for export and partly by the fact that export trading had been held back because terms and credit accommodations had not been worked out satisfactorily.

A graphic presentation of chemical progress during the past decade will be found in the editorial supplement that accompanies this February issue of *Chem. & Met.* Weighted indexes of chemical consumption and prices are charted by years and months and space has been provided for continuing these curves through 1940 as the current data become available. Such a record should prove helpful to all who are concerned with production trends during the interesting and critical months that are ahead.

INDEX OF BUSINESS ACTIVITY
1923-25=100
1923-25=100
150
140
130
120
110
100
90
80
70
60
50
40
J O S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
34
1935
1936
1937
1938
1939

CHEM. & MET. REPORT

ON CHEMICAL RAW MATERIALS

Contents

Mineral Acids and Sulphur 68
Alkalis and Chlorine 70
Fertilizers and Materials 72
Pigments 76
Synthetic Fibers 77
Plastics 78
Synthetic Organic Chemicals 80
Gas and Coal Products 82
Alcohol and Solvents 84
Salt Cake 86
Oils and Fats 87
Turpentine and Rosin 91
Foreign Trade 92

MINERAL ACIDS AND SULPHUR

SUMMARY: *Sulphuric acid experienced a good year in 1939, with both production and consumption at a rate exceeded only in 1929 and 1937. Consumption is estimated at 8,181,000 short tons on a 50 deg. Bé. basis and production at 8,351,000 short tons. Sulphur production fell considerably below 1938, but both domestic shipments and exports considerably exceeded that year. Other mineral acids are believed to have been substantially better than in 1938, with production only about 5 per cent below 1937.*

EVERY major type of consumption for sulphuric acid showed a substantial gain in 1939 compared with 1938, and few of them were much below the high level attained in 1937. Several consuming groups, in fact, exceeded 1937 by small percentages. Total consumption, estimated at 8,181,000 short tons of acid, reduced to a 50 deg. Bé. basis, was 22.5 per cent above the 6,678,000 tons estimated for 1938, and only 4.3 per cent below the record year of 1937. The earlier peak year of 1929 exceeded 1939 by only 1.6 per cent. Similarly, production for the year was at a high level estimated at about 8,351,000 short tons, which was 23.2 per cent above 1938 and close to that of 1929.

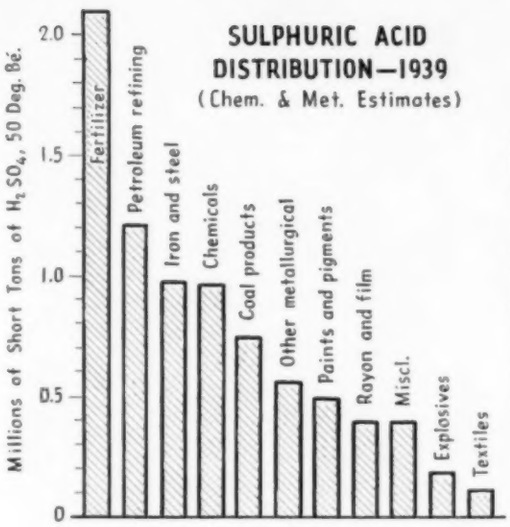
Among the various consuming groups, the greatest increase over the preceding year was registered in the iron and steel industry which consumed some 66 per cent more acid than in 1938 and only about 11 per cent below the 1937 peak. It should be noted that the figures given in our distribution tables this year for consumption in iron and steel are not directly comparable with those in earlier Annual Review numbers. It is felt that our consumption figures in earlier years were considerably too low for pickling operations, and by use of trade estimates, and figures secured in an investigation recently conducted by the American Iron and Steel Institute, the data for 1937–39 have been brought more nearly in line with the facts.

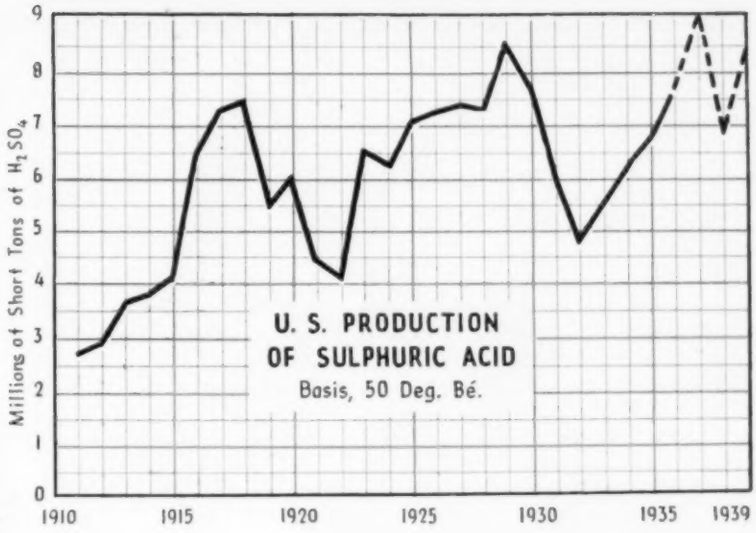
Other metallurgical operations shared the activity of the steel industry, utilizing increased acid to the extent of some 63 per cent. Continuing increase in titanium dioxide production accounted for the use of nearly 40 per cent more acid in the paint and pigment field. Although a comparatively small user of sulphuric acid on account of recovery processes, the explosives industry is estimated to have required over 35 per cent more acid in 1939 than in 1938. Incidentally, the allocation made of acid usage to this industry has been revised downward this year, as compared with earlier estimates.

Another relatively small use, in the textile industry, accounted for some 29 per cent more acid than in the earlier year, owing to a high level of activity in wool carbonizing. Production of sulphate of ammonia in coal products operations to some extent reflected the activity of the steel industry, showing increased acid use of 26.5 per cent.

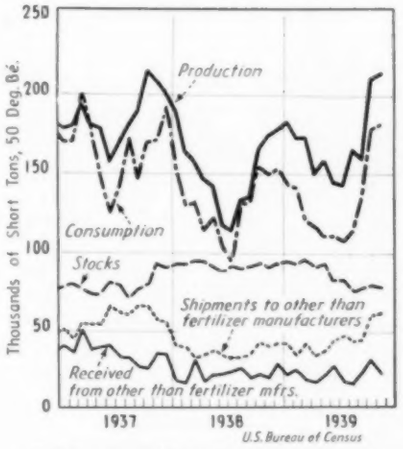
Viscose products established a new record in 1939 and so required nearly 26 per cent more acid than in 1938 (and 5.5 per cent more than in the previous peak year of 1937). Viscose filament yarns did not quite equal 1937, but the increase in staple and transparent wrapping films more than offset this small decrease. The chemical group closely reflected the change in our chemical consumption index from 1938 to 1939 and established an increased acid use of some 22 per cent, while miscellaneous small uses of the acid required an average of 11 per cent more than in 1938.

The smallest increases were reflected in the two largest using groups, fertilizers and petroleum refining. The latter showed an approximate 10 per cent increase over the two preceding years, while fertilizer manufacture required slightly under 10 per cent more than in 1938, and 6 per cent less than in 1937.





In our review of 1938 (February, 1939) it was pointed out that new catalytic refining processes in the petroleum industry gave promise of reversing the long-time trend toward reduction in acid requirements per unit of run-to-stills. This situation is now somewhat clearer, although still in doubt regarding the eventual effect, owing to the widely varying requirements for different charging stocks, and because of the fact that the discharged acid can either be recovered in considerable part, or used in place of new acid for other acid-treating operations in the refinery. The sulphuric acid alkylation process for high octane aviation fuels now appears to be firmly entrenched in the United States with plants totaling about 11,500 bbl. per day of aviation alkylate either completed, under construction, or being considered. Assuming an average acid make-up requirement of 63 lb. per bbl., these plants would need some 130,000 tons per year of 96–100 per cent acid. If recovered with a loss of some 20 per cent, 26,000 tons per year of new 98 per cent acid would be needed, but it is probable that a considerable part of the requirements will be met by using the diluted alkylation acid instead of new acid for treating naphthas and light fuel oils.



Sulphuric acid in fertilizer plants

An accompanying table presents the situation in sulphur production and use, and in acid manufacture for the years 1937 to 1939, as nearly as it can be gaged from trade and *Chem. & Met.* estimates, and U. S. Bureau of Mines figures. Sulphur mining, exports, shipments and stocks at mines, and pyrites imports and domestic pyrites consumption for 1937 and 1938 are Bureau of Mines figures. All others are estimates.

Including a small production of sulphur mined in California and Utah, primary sulphur production in the United States in 1939 was about 2,092,000 long tons, or less than 1937 production by 23.7 per cent, and 1938, by 12.6 per cent. However, domestic shipments from the mines fell but 11 per cent below 1937 and exceeded 1938 shipments by nearly 52 per cent. Exports of sulphur also increased.

There was also a small amount of byproduct elemental sulphur used during the year. About 11,000 tons of sulphur recovered from smelter gases at Trail, B. C., was imported by the northwestern pulp industry, while 5,000–6,000 tons of elemental sulphur recovered in wet fuel gas purification

Estimated Distribution of Sulphuric Acid Consumed in the United States

(Basis, 50 deg. Bé.)

Consuming Industries	1937 Short Tons (Revised)	1938 Short Tons (Revised)	1939 Short Tons
Fertilizers	2,230,000	1,920,000	2,100,000
Petroleum refining	1,100,000	1,100,000	1,210,000
Chemicals	1,020,000	800,000	975,000
Coal products	865,000	585,000	740,000
Iron and steel	1,100,000	590,000	980,000
Other metallurgical	625,000	350,000	570,000
Paints and pigments	525,000	430,000	500,000
Explosives	180,000	140,000	190,000
Rayon and cellulose film	380,000	318,000	400,000
Textiles	112,000	90,000	116,000
Miscellaneous	450,000	355,000	400,000
Totals	8,587,000	6,678,000	8,181,000

Data and Estimates on U. S. Sulphur Activity and Sulphuric Acid Production, 1937–1939

(Sulphur and pyrites in long tons; acid in short tons, 50 deg. Bé.)

	1937	1938	1939
Sulphur mined	2,741,970	2,393,408	2,092,000
Sulphur exports	675,297	575,957	635,000
Domestic shipments	1,791,215	1,052,890	1,595,000*
Approx. mine stocks at end of year	3,400,000	4,200,000	4,060,000
Non-acid uses of sulphur	564,000	350,000	495,000
Sulphur available for acid	1,227,000	703,000	1,100,000
Change in consumer stocks	+135,000	−50,000	+100,000
Acid from sulphur	5,690,000	3,930,000	5,208,000
Pyrites imports	524,430	334,234	490,000
Change in consumer stocks	+100,000	?	+90,000
Domestic pyrites	584,166	555,629	530,000
Acid from pyrites	2,260,000	1,990,000	2,076,000
Acid from smelters	1,050,000	860,000	984,000
Acid from hydrogen sulphide	†	†	83,000
Total sulphuric acid made	9,000,000‡	6,780,000	8,351,000

* Does not include imports of about 11,000 tons from Trail, B. C., nor shipments of about 6,000 tons of byproduct elemental sulphur from fuel gases. Both used for purposes other than acid; not included above in "non-acid uses."

† Possibly 20,000 tons in 1937 and 40,000 in 1938; not included in total.

‡ U. S. Bureau of Census gives revised figure of 7,946,695 tons, which we believe incomplete.

operations went into spray, insecticide and similar uses.

In addition to recovered elemental sulphur, recovered H_2S from petroleum gases is beginning to play a larger part. A. R. Powell (*Ind. Eng. Chem.*, p. 796, 1939) estimated that H_2S equivalent to 35,000 tons of sulphur was removed from such gases by Koppers phenolate, Shell phosphate and Gerbotol processes in 1939 and that 40,000 tons annually soon will be removed. However, a considerable part of this H_2S is at present burned and probably not over about 22,000 tons of sulphur equivalent is at present available to sulphuric acid plants. Current estimates place the actual 1939 usage at not over about 16,000 tons equivalent sulphur.

Not all of the domestically available sulphur went to acid, however, for in addition to the byproduct elemental sulphur mentioned, in the neighborhood of 495,000 long tons was employed for non-acid uses. Furthermore trade authorities believe that approximately 100,000 tons went to increase users' stocks. This leaves a production of acid from sulphur in the neighborhood of 5,208,000 short tons on a 50 deg. Bé. basis. It will be noted that there is an apparent continuing increase in both sulphur and pyrites stocks in users' hands. This is one of the reasons why it has been found impossible in recent years to calculate an acid make as low as apparent consumption, and why we cannot justify our estimated production (or consumption) with the 1937 Census figure, even in its recently revised form.

Based on 11 months' figures, pyrites imports appear to have been at least 490,000 long tons while an estimated consumption of 530,000 long tons of domestic pyrites also took place. Allowing for increase in pyrites stocks, an acid production of 2,076,000 short tons appears to be likely from this source, with 984,000 tons from waste gases at copper and zinc smelters and 83,000 tons from waste H_2S. Thus it seems probable that acid production totaled close to 8,351,000 short tons, or about 2.1 per cent more than we have been able to allocate to consumption.

A relatively small amount of acid plant construction was completed or commenced in 1939, roughly 250 tons daily capacity on a 100 per cent acid basis. Included in the total was one enlargement and one sludge conversion plant. There was also a relatively small increase in nitric acid capacity, all based on ammonia oxidation. Some further investigation of the gypsum process for sulphuric acid was reported, apparently without favorable conclusions having been reached.

ALKALIS AND CHLORINE

SUMMARY: *Alkalis experienced a good year in 1939, particularly in the last quarter which pushed ash production to above capacity rates. Both soda ash and caustic soda production and consumption reached levels only slightly below the previous peak year of 1937 and well above 1929. Caustic soda producers in particular had reason to be well pleased, since the remains of the stock surpluses of pre-1937 were largely exhausted. Chlorine production, although no longer forced by sharply rising demand, apparently reached a new record slightly above the 1937 level.*

A YEAR of considerably improved business as compared with 1938, and nearly at the level of 1937, was experienced by the alkali industry in 1939. Caustic soda production was estimated to be only about 4 per cent below the record level of 1937, while soda ash production was believed to have come within 2½ per cent of the peak attained by that part of the industry, also in 1937. Production of ammonia soda during the last quarter of the year was, in fact, greater than rated capacity. Although the pressure of excessive chlorine demands was relieved in 1938 and neither that year nor 1939 was an exciting one for chlorine, still the indications are that production of this gas slightly exceeded its previous high point in 1937, probably by about 2 per cent. This was accomplished without forcing electrolytic caustic soda production and the caustic industry in 1938 and 1939 was, therefore, able to clean its warehouses of the accumulated surplus stocks which had proved so troublesome during the period of pyramiding chlorine demands culminated in 1937.

Soda-ash production, estimated to have totaled approximately 2,960,000 short tons in 1939, was believed to be made up of about 2,850,000 tons of ammonia soda ash, 103,000 tons of natural soda, and 7,000 tons of electrolytic soda produced at pulp mills. This compares with our corresponding 1938 estimate of 2,500,000 tons total, 2,400,000 tons of ammonia soda ash and 100,000 tons of natural and electrolytic soda; and with the 1937 Census figures of 3,037,421 tons total, 2,918,668 tons of ammonia soda ash and 118,753 tons of natural and electrolytic soda.

Distribution of soda ash production exhibited practically the same variations among the several years as production, according to our estimates as indicated by one of the tabulations on the following page. Sales of soda ash as such, however, increased by an even higher percentage over 1938. Total sales for 1939 are estimated at 2,249,000 tons or 21.8 per cent above the 1,849,000 tons estimated for 1938, and 3.6 per cent below the 2,323,759 tons of ash sales shown by the Census for 1937. Soda ash sales, of course, differ from production by the amount of the change in stocks plus the ash consumed by the manufacturers in lime-soda caustic and refined bicarbonate of soda production.

In past annual reviews, our estimates of soda ash and caustic soda distribution have been based only on that part of the total production that was sold by the primary producer. Hence they were incomplete to the extent that these materials were consumed within the manufacturing plants. With an average of about 28 per cent of the total ash production so consumed, and some 5 to 10 per cent of the total caustic made converted to other chemicals in the original plant, our distribution esti-

Production of Caustic Soda in the United States

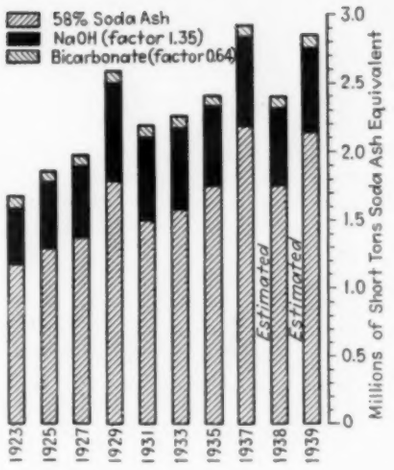
(Short Tons)

Year*	Lime-Soda	Electrolytic	Total
1921	163,044	75,547	238,591
1923	314,195	122,424	436,619
1925	355,783	141,478	497,261
1927	387,235	186,182	573,417
1929	524,985	236,807	761,792
1931	455,832	203,057	658,887
1933	439,363	247,620	686,983
1935	436,980	322,401	759,381
1937 (revised)	488,807	479,919	968,726
1938 (revised)	420,000	415,000	835,000
1939 (estimated)	465,000	465,000	930,000

* Figures for 1921–1937 are from the U. S. Bureau of the Census. Electrolytic caustic soda figures do not include that made and consumed at wood-pulp mills, estimated at about 30 000 tons in 1927 and 1929, at about 24,000 tons in 1931, 21,000 tons in 1933, 20,000 tons in 1934, 17,000 tons in 1935, 19,000 tons in 1936 and 1937, 18,000 tons in 1938, and 19,000 tons in 1939.

mates heretofore have neglected important applications of these materials. The current estimates, therefore, have been based on a total distribution of both soda ash and caustic, and as will be seen from the accompanying tables have been converted to the new base back to 1937. Our chart of distribution of ammonia soda ash products, however, has been kept on a "for sale" basis and thus for any one year gives an approximate picture of the business of the ammonia soda ash producers (not including natural and electrolytic soda ash), showing ash sold as such, and the ash equivalents of the caustic soda and refined bicarbonate produced.

From the soda ash distribution tables, several interesting consumption changes from 1938 to 1939 are evident. The average rise was 15.1 per cent, where exports, relatively small on a tonnage basis, showed the largest increase of nearly 65 per cent. Another small user, textiles, required over 43 per cent more ash owing to the active wool year. Glass, the largest consuming field, had a very active fourth quarter and increased its ash requirements by nearly 26 per cent during the year. Pulp and paper, next in order of increase, consumed about 23.5 per cent more ash, and chemicals other than caustic and bicarbonate, over 15 per cent in excess of 1938.



Production for sale of principal ammonia soda products (ash equivalents)

Increase in cleansers and modified sodas was of the order of 14 per cent, comparable to the acceleration in miscellaneous uses, while ash going to petroleum refining is estimated at 10 per cent above 1938. Use of ash for making caustic soda and bicarbonate of soda increased by nearly as large a percentage, with about a 9 per cent rise in water softeners. Soap, always a stable industry, nevertheless increased its ash requirements by an estimated 5.9 per cent.

Caustic soda production, detailed in an accompanying tabulation, is estimated to have been some 930,000 short tons, composed of 465,000 tons each of lime-soda and electrolytic caustic, compared with our revised estimate of 420,000 tons of lime-soda caustic and 415,000 tons electrolytic caustic in 1938; and the revised Census figures of 488,807 tons of lime-soda caustic and 479,919 tons of electrolytic caustic in 1937. In addition, as noted in the footnote to the table, there is a small estimated production of electrolytic caustic, made mostly in pulp mills, and not included in the Census.

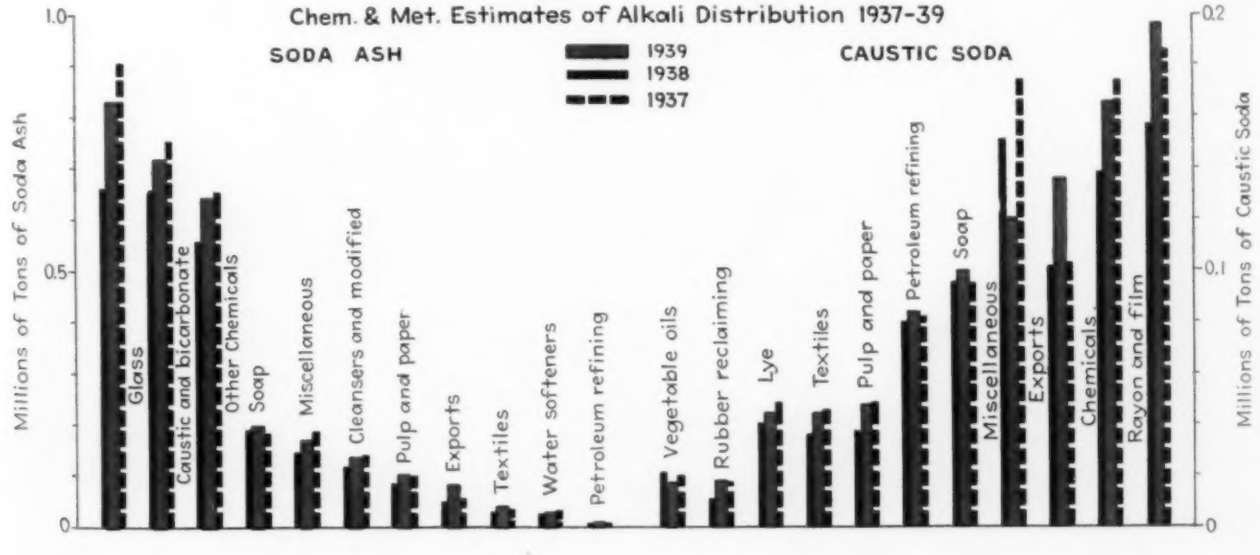
As noted in the case of our soda ash distribution estimates, the tabulation for caustic soda is now presented on a total distribution basis. With a total consumption increase of over 12 per cent compared with 1938, the small use in rubber reclaiming rose some 64 per cent, while exports in-

Estimated Distribution of Soda Ash Consumed in the United States

Consuming Industries	1937 Short Tons (Revised)	1938 Short Tons (Revised)	1939 Short Tons
Glass	903,000	660,000	830,000
Soap	180,000	187,000	198,000
Caustic and bicarbonate	751,000	655,000	716,000
Other chemicals	650,000	556,000	640,000
Cleansers and modified sodas	140,000	120,000	137,000
Pulp and paper	104,000	85,000	105,000
Water softeners	32,000	27,000	30,000
Petroleum refining	10,000	10,000	11,000
Textiles	38,000	30,000	43,000
Exports	55,000	51,000	84,000
Miscellaneous	184,000	149,000	170,000
Totals	3,037,000	2,530,000	2,964,000

Estimated Distribution of Caustic Soda Consumed in the United States

Consuming Industries	1937 Short Tons (Revised)	1938 Short Tons (Revised)	1939 Short Tons
Soap	94,000	95,000	100,000
Chemicals	173,000	138,000	165,000
Petroleum refining	82,000	80,000	84,000
Rayon and cellulose film	186,000	156,000	196,000
Lye	48,000	40,000	44,000
Textiles	45,000	36,000	44,000
Rubber reclaiming	17,000	11,000	18,000
Vegetable oils	20,000	21,000	17,000
Pulp and paper	48,000	37,000	47,000
Exports	102,000	101,000	135,000
Miscellaneous	173,000	150,000	120,000
Totals	988,000	865,000	970,000



creased nearly 34 per cent. Owing to large boxboard production, use in the pulp and paper field is estimated at 27 per cent over 1938, with nearly 26 per cent more caustic going into viscose products on account of the phenomenal record established by rayon in 1939. Textile requirements were up perhaps 22 per cent and use in chemicals nearly 20 per cent. About a 10 per cent increase in lye and rises of 5.6 per cent in soap and 5 per cent in petroleum refining complete the plus side of the picture. Miscellaneous uses fell some 20 per cent owing to stock withdrawls; while reduction in vegetable oil refining amounted to perhaps 19 per cent.

As mentioned above, 1939 chlorine production, which we estimated at 455,000 tons total, probably exceeded the 1937 peak of 446,261 tons by about the small margin indicated. Of this, some 415,000 tons was produced as a co-product with electrolytic caustic and perhaps 40,000 tons in the making of metallic magnesium and sodium, caustic potash, electrolytic soda ash, and sodium nitrate by the nitric acid and salt process. Although a year ago our information indicated that perhaps twice this 40,000 ton total could be produced from these miscellaneous sources, trade opinion at present indicates the lower quantity as more likely. On this basis the 1937 production is estimated to have been split between 426,000 tons produced with caustic soda, and 20,000 tons from other sources; while for 1938 the estimated total of 405,000 tons was distributed between 370,000 tons with caustic soda and 35,000 tons from other sources. Just how the chlorine production is at present consumed is a moot question. Best information indicates that only about 21 per cent is now going to pulp bleaching compared with 27–28 per cent a decade ago. Some 60 per cent is believed to have been used in chemicals in 1939, leaving about 5 per cent for textiles, 6 per cent for sanitation and 8 per cent for all other uses.

Viscose products, the largest user of caustic soda, continue to increase their efficiency of use. Where ten years ago the rayon industry consumed about 1.6 lb. of 76 per cent Na_2O caustic per pound of product, today the average has fallen to about 1.15 lb. and one large producer is coming close to a pound-for-pound ratio, an efficiency of some 75 per cent referred to theoretical recovery. A trend of some importance in the viscose industry is the recovery of waste sodium sulphate from the coagulating bath.

FERTILIZER AND MATERIALS

SUMMARY: *Production and sale of fertilizer in 1939 were not quite equal to the maximum previous year in tonnage and value, although not far below. It is estimated that some 7.7 million tons was marketed, compared with 7.5 million in 1938 and 8.1 million in the peak year of 1937. Few outstanding changes in technology occurred, but the year showed a continuing trend toward more concentrated fertilizer and its wider use on crops formerly considered secondary. Among fertilizer materials, nitrogen was normal, and potash consumption at a near-record rate. Despite reduction in imports with the advent of European hostilities, domestic potash stocks took care of production deficiencies and producers moved rapidly toward a position of American self-sufficiency in this indispensable fertilizer chemical.*

FOR THE PAST 50 years there has been a steady increase in the concentration of plant foods in the commercial fertilizer employed by farmers. This has been possible because chemical enterprise has constantly furnished superphosphate and other chemical products in higher purity or of higher concentration to support the continuing effort of the fertilizer industry to sell high concentration mixed fertilizer. From 1910 to 1940 there appears to have been almost a uniform increase in the concentration of P_2O_5 in superphosphate from a trifle below 16 per cent up to almost 20 per cent. If this trend continues as expected the average in 1940 should be almost exactly 20 per cent, according to the data of A. L. Mehring of the U. S. Department of Agriculture.

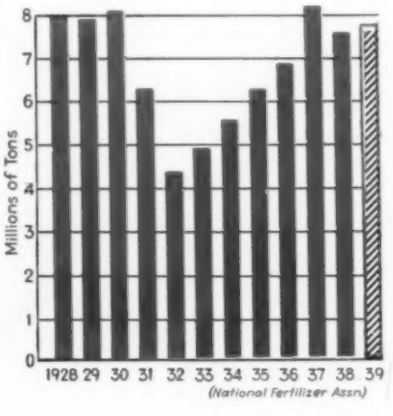
Even war-time interruption of trade in fertilizer materials has not caused any serious difficulty for the industry. A few minor modifications of formulas are necessary. But in no significant cases has there been difficulty in securing a sufficient quantity of all essential plant foods. Even the potash supply, which many felt would be seriously reduced, continues adequate.

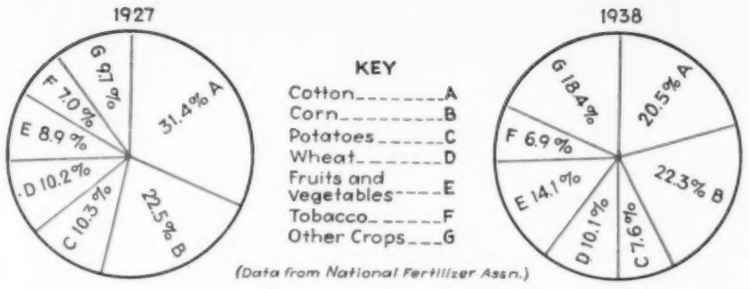
During 1939 both economic and technologic factors tended to continue the trend toward two distinct divisions of the fertilizer industry. One part is made up of the materials producers who supply nitrogen, potash and phosphate chemicals. The work of this division is essentially chemical engineering, only occasionally of by-product nature. The second division of the industry does the mixing and the merchandising. The separation of the two divisions has not necessarily been of a corporate nature, but has often consisted in centralization of production of materials, with plants for mixing and marketing at widely scattered points near important centers of use. This has given an opportunity for centralization of the technical work in large enough units to permit use of modern equipment and methods under chemical engineering direction.

The mixing and merchandising establishments neither have nor seriously need such technical control, since they work largely from predetermined formulas. They are, in fact, becoming more the service units of the industry, adapting to local needs the varied raw materials which the chemical engineering enterprises of the country supply.

A decade ago the five main crops on which fertilizer is used were the same as today, namely, corn, cotton, tobacco, wheat, and potatoes. But in the past decade the share of the total fertilizer business found in the cotton and potato industries has shrunk, particularly the sales for cotton culture. Many crops relatively little fertilized 10 or 15 years ago are now becoming important markets for the fertilizer industry. Today these "miscellaneous crops" take nearly twice as large a percentage of the total sales as they did in 1928. This relationship is brought out strikingly in the accompanying charts based on those recently issued by the National Fertilizer Association.

United States fertilizer consumption, 1928 to 1939

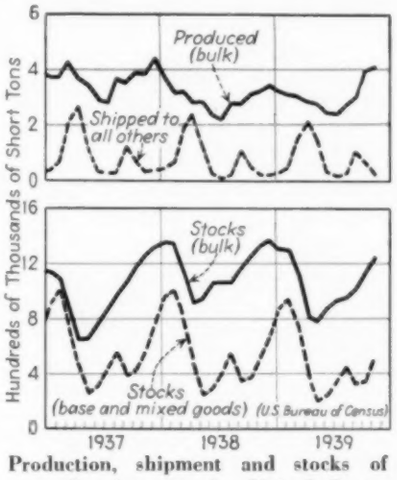




Distribution of fertilizer consumption by crops fertilized, 1927 and 1938

One of the outstanding achievements last year is the movement toward pasture fertilization. Until quite recently few farmers or stock growers realized the great advantage possible from the generous use of fertilizer on pasture land. Formerly the cows took what grass the current season happened to provide. Now, good pasture is maintained to a considerable extent by use of something approaching 150,000 tons per year of fertilizer.

The economic advantage to the farmer himself is the measure which rightly should be applied to fertilizer sales. Unless the buying of fertilizer is profitable to the individual, one cannot expect growth in business. Therefore, in recent months the National Fertilizer Association has been making a consumer survey, during which interviews have been had with about 32,000 farmers. The results show that the vast majority of agricultural workers believe in fertilizers. More are testing new kinds; more understand the proper grade and usage. Many more of them are convinced that it is profitable. The reports of



Production, shipment and stocks of superphosphate in the United States, 1937–39

the benefits obtained are impressive. On the average, the many thousands of farmers interviewed said that they got $3.60 in crop benefit for each dollar spent on fertilizer, in addition to improvement in the land for subsequent crops. Forecasters are anticipating sales and use of fertilizer in 1940 about equal to 1939.

Fertilizer Use by Crops, 1938

(Data from National Fertilizer Assn.)

Crop	Total Use, 1,000 Tons	Per Cent of Total	Crop Yields, Bu. per Acre With Fertilizer	Crop Yields, Bu. per Acre Without Fertilizer	Dollar Return* per Dollar Spent
Corn	1,675	22.3	34	20	2.07
Cotton	1,540	20.5	342 lb.	134 lb.	4.47
Fruits and vegetables	1,050	14.1	....	...	3.82
Wheat	758	10.1	22	13	1.76
Potatoes	570	7.6	205	88	3.11
Tobacco	517	6.9	1,076 lb.	453 lb.	9.04
All other	1,390	18.5	....	...	....
Total	7,500	100.0	....	...	(av) 3.60

* Figures represent *increase* in crop value per dollar spent for fertilizer.

Fertilizer Phosphates

The phosphate rock and superphosphate industry of America completed during 1939 a self-analysis that gives a far better understanding of the scope and character of that important mineral products industry than was ever before available. This effort was undertaken as a result of legislation proposed in Washington for the regulation of the export of phosphate rock. That idea had its origin in the assumption that the high-grade phosphate rock reserves of the United States were being exhausted at a dangerously rapid rate by export. The industry would not accept that assumption, but it had relatively little factual matter to prove the theory erroneous.

The Phosphate Rock Institute was instrumental in organizing the study from which rather important new information has developed. Present estimates make it certain that this country has an abundant supply of phosphate reserves for many generations to come. The study also brought out facts not previously well understood as to why the present reserves are in fact greater (from a practical point of view) than appeared to be the case a decade or more ago. Not only new knowledge of what is in the ground has increased the reserves, but also improved methods of mining, beneficiation and use which step up recovery and make available phosphates formerly not commercially usable.

The actual production of superphosphate in the United States during 1939 apparently exceeded the output for any previous Recovery year except 1937. Stocks also declined somewhat, and the concentration of P_2O_5 last year was probably higher than ever before. At the present time, typically, the maker of superphosphate uses a 77 to 78 per cent rock, the product averaging nearly 19.5 per cent P_2O_5 in the run-of-pile.

The trend to higher concentration

Fertilizer Material Used in Continental United States, Fertilizer Year 1938–39

(Short tons: estimates by Synthetic Nitrogen Products Corp.)

	Total Material	Plant Food N	Plant Food P_2O_5	Plant Food K_2O	Applied* Directly
Sulphate of ammonia	515,000	106,100	.....	.....	151,000
Nitrate of soda	700,000	112,200	.....	.....	602,000
Byproduct ammonia liquor	35,000	7,500	.....	.....	.....
Synthetic N-containing solutions	79,000	35,500	.....	.....	3,000
Cyanamide	120,000	25,800	.....	.....	70,000
Calcium nitrate and urea fertilizers	125,000	26,100	.....	.....	59,000
Imported complete fertilizers	2,000	300	500	300	.....
Ammonium phosphates	56,000	7,200	22,400	.....	18,000
Nitrate of potash, nitrate of soda-potash	42,000	5,900	.....	8,700	22,000
Other potash materials	670,000	.....	.....	344,700	90,000
Cottonseed meal	150,000	9,000	3,600	2,700	100,000
Other natural organics	645,000	31,800	27,000	5,500	175,000
Bulk superphosphate	3,253,000	.....	605,600	.....	†825,000
Basic slag	35,000	.....	3,500	.....	35,000
Bones, bone meal	93,000	2,100	22,500	.....	60,000
Ground phosphate rock	140,000	.....	5,600	.....	90,000
Sulphuric acid (for acidulating certain organics)	5,000	.....	.....	.....	.....
Wood, beet root ashes	14,000	.....	.....	600	10,000
Dolomite, limestone	350,000	.....	.....	.....	.....
Calcined kieserite and other secondary plant food materials	20,000	.....	.....	.....	5,000
Filler	636,000	.....	.....	.....	.....
Total tonnage	7,685,000	369,500	690,700	362,500	2,315,000

* Materials not used in mixed fertilizers; includes materials used in home-made mixtures except liming materials.

† Includes about 20,000 tons of "basic lime phosphate." Does not include triple super distributed by T.V.A. and A.A.A.

of P_2O_5 has been encouraged by two factors. The government and the industry have both aggressively urged agriculture to use more concentrated materials as a matter of over-all economy. In the second place, a number of states (about 22) have by law fixed minimums of plant food for commercial fertilizer which are so high that many of the common grades distributed a decade ago can no longer be sold legally. There is every reason to believe that this trend will continue.

Last year probably made a record for all time for the production of high concentration superphosphate, commonly called triple-super. The government alone used over 122,000 tons of that material, ranging from 45 to 48 per cent by weight of P_2O_5. Approximately one-quarter of that amount was bought by A.A.A. from Tennessee Valley Authority. The balance was purchased on competitive contracts from the commercial fertilizer makers. All of this was distributed by A.A.A. as a part of its soil improvement program. As such it was billed to farmers cooperating in the soil conservation plans of the year, and was used by them on pasture, legumes, and other soil-building crops. In addition there were substantial tonnages sold by commercial producers and large quantities used for making of 20 per cent or higher grade superphosphate and high concentration mixed fertilizer.

The T.V.A. organization at Muscle Shoals actively continued its work on manufacture and experimental use of metaphosphate, the high concentration plant food which contains about 60 per cent P_2O_5. Its report, released at the year-end, indicates that about 4,600 tons of "metaphos" was made during the last fiscal year (ended June 30, 1939). Use has been limited thus far to experimental application to determine its agronomic significance. During that same fiscal year T.V.A. also produced from electric furnace phosphoric acid 69,000 tons of high concentration superphosphate containing on the average about 47 per cent of P_2O_5.

During the year T.V.A. was given funds for the erection of a new experimental blast furnace for the manufacture of phosphoric acid and other concentrated phosphate products. Research, development, and design work has continued on this project, but construction is not expected to begin until some months of 1940 have passed.

Intermittently during 1939 there continued discussion of plans for building a phosphate fertilizer plant either near the Bonneville Dam on the Columbia River or in the Intermountain country of Idaho. Since Congress has not given any specific authority nor made any special appropriations for this purpose, the projects remained at the "talk stage."

Imports of phosphate materials into the United States in 1939 were, as usual, almost negligible. Exports of phosphate rock and superphosphate during the early part of the year were not much different than in other recent seasons, but these exports fell off significantly after the beginning of European hositilities.

United States Synthetic Nitrogen Balance, Fertilizer Year 1938–39

(Based on estimates prepared by Synthetic Nitrogen Products Corp.)

	Equivalent Short Tons of Nitrogen
SUPPLIES	
Estimated output of	
Plant at Hopewell	97,400
Plant at Belle	95,700
Shell plant	15,000
Several small plants	7,000
Total	215,100
DISPOSITION	
Consumed by U. S. agriculture in N-containing solutions, ammonia and ammonium phosphate	44,500
Consumed by U. S. agriculture as nitrate of soda (156,000 tons)	25,400
Consumed by Puerto Rican and Hawaiian agriculture as nitrate of soda (4,000 tons)	700
Consumed as sulphate of ammonia, mostly in U. S. agriculture (65,000 tons)	14,700
Consumed as nitrate of soda by U. S. industries (90,000 tons)	13,000
Consumed as ammonia and miscl. by U. S. industries	91,100
Exported as nitrate of soda (143,000 tons) and as urea and similar	23,600
Exported as anhydrous ammonia, etc.	1,700
Total	215,100

Nitrogen

During the past year industrial nitrogen developments responded in a normal fashion to the varying commercial factors. Byproduct ammonia production increased in response to renewed activity in the steel industry with its accompanying increase in demand for coal. Synthetic production promptly supplied all added market requirements. Imports were substantially the same as during the preceding year. Exports fell off a trifle, largely during the last few months when ocean movement of exported synthetic sodium nitrate was slow.

All this conventional behavior of so important a war-time element as nitrogen contrasts sharply with the commercial reactions of the World War period. No longer do most of the important industrial nations worry regarding international trade for supply of explosive or other industrial nitrogen compounds. The national self-sufficiency programs which dominated developments during the '20's bear fruit in self-satisfaction today.

Consumption of Natural Organics for Fertilizer Purposes in Continental United States, 1938–39

(Source: Synthetic Nitrogen Products Corp.)

Materials	Short Tons of Material	Short Tons of Nitrogen
Cottonseed meal	150,000	9,000
Other seed meals	20,000	1,000
Process tankage	80,000	6,700
Animal tankage	40,000	3,000
Fish scrap and meal	80,000	6,400
Dried blood	10,000	1,300
Garbage tankage	60,000	1,700
Sewage sludge	80,000	4,400
Guano	15,000	1,200
Castor and tung pomace	25,000	1,300
Cocoa and other shells	25,000	600
Various rough ammoniates	10,000	600
Dried manure	60,000	800
Bones and bone meal	80,000	2,000
Bone black, dissolved	8,000	100
Tobacco stems	90,000	1,800
Peat	50,000	1,000
Totals	883,000	42,900

Sodium Nitrate in Chile

(Data from American Commercial Attaché, Santiago, expressed in thousands of metric tons)

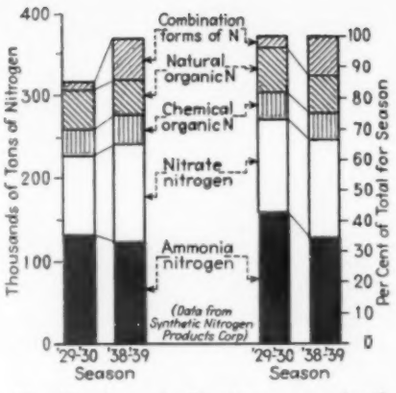
Season	Production	Exports	Sales	Stocks at End of Fiscal Year
1933/34	530	1,182	1,021	1,768
1934/35	1,136	1,271	1,274	1,629
1935/36	1,216	1,342	1,346	1,500
1936/37	1,290	1,500	1,562	1,228
1937/38	1,420	1,544	1,578	1,071
1938/39	1,427	1,587	1,557	941

Potash

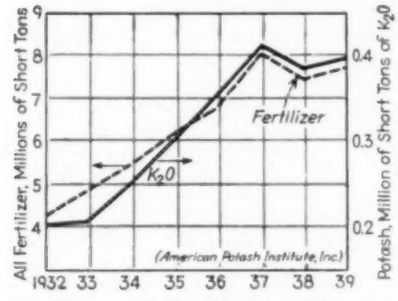
Potash supply for American fertilizer and American chemical industry is assured despite the interruption of imports from Europe. American producers have not picked up the entire load as yet, but the stocks on hand will suffice to fill much of the gap between the former rate of production and the total United States requirements. American producers have made sure that the rest of the deficiency will be cared for by canceling export business until such time as production capacity can be built up more nearly to meet requirements.

In 1939 deliveries of potash chemicals to the fertilizer industry by domestic producers and importers amounted to approximately 360,000 tons of contained K_2O. During the same year chemical users were supplied with materials containing about 25,000 tons of K_2O, all as muriate and sulphate.

The deliveries of agricultural potash were approximately 100,000 tons less than during the previous calendar year, although stocks were drawn



Classification of all nitrogenous fertilizer materials consumed in continental United States, 1929–30 and 1938–39


All Fertilizer, Millions of Short Tons
Potash, Million of Short Tons of K_2O
Fertilizer
K_2O
(American Potash Institute, Inc.)
1932 33 34 35 36 37 38 39

Fertilizer and fertilizer potash consumption in United States, Canada, Cuba, Hawaii and Puerto Rico

upon and consumption was probably a little greater. When 1939 opened there were substantial stocks of potash on hand. At the year-end, however, every potash bin was scraped clean. The actual consumption in 1939 was probably close to the 1937 all-time record for K_2O use as a plant food by American agriculture.

During 1939 the three major producers of potash were, as in former years, American Potash & Chemical Co.; U. S. Potash Co.; Potash Co. of America. Nearly a dozen other small operations furnished some byproduct output or minor recovery of natural materials. Imports by the American firm representing the European cartel continued more or less normal until the outbreak of hostilities in Europe. The stocks on hand at the beginning of September were sufficient to permit continuance of deliveries during that month, and even early October was not much below normal; but imports were practically cut off thereafter for a period of some weeks. Practically no potash was imported during November and the total for the year was no more than two-thirds of the imports during the previous year, about one-third of the imports in the boom season of 1937.

The firm which has represented European cartel producers in the United States, N. V. Potash Export My., has discontinued operations, being in effect replaced by two concerns. The French Potash Co., Inc., representing French producing firms is bringing in some potash and is hopeful of supplying substantial quantities despite water-transport troubles. Pioneer Potash Corp. has recently been organized to be the American importing and distributing agent for material which comes from Holland, presumably material of German origin. Forecasts differ as to whether the British control of sea freight will permit any of these goods to come regularly through the blockade after the stocks that were on hand in Holland at the outbreak of hostilities are exhausted.

During 1939 Union Potash & Chemical Co. completed its mine shaft near Carlsbad, N. M. The parent enterprise, International Agricultural Corp., shortly afterward announced plans for installing a refinery having a capacity of 70,000 tons per year of potassium sulphate or an equivalent tonnage of 60 per cent muriate. Operation during the summer or early fall of 1940 was forecast. Since much of the mineral hoisted from this first shaft is langbeinite, a double sulphate, it is logical that one of the primary products here should be sulphate. A promised plan for expenditure of $2,000,000 for mining and processing facilities indicates that this unit is soon likely to become a fourth major domestic producer.

Some expansion of present facilities has been and will be made in the refineries of the three important American companies now operating, so these firms may pick up as much of the total business as they can. Existing facilities at the mines are quite adequate to hoist raw mineral more than equal to the entire domestic needs of the country for both fertilizer and chemicals usage. This means that there need be no shortage of potash, but it does not alone insure that the fertilizer makers can get this plant food in the customary or desirable concentrated forms.

At the beginning of 1940 the capacity of refineries for the making of 50 per cent or 60 per cent muriate is estimated variously at from 330,000 tons of K_2O equivalent per year, upward. A substantial increase in this capacity will undoubtedly occur, despite the plan to convert some of the muriate into sulphate. The result, with the inclusion of the Union concern, will be an ability to make concentrated

Potash Deliveries in United States, Canada, Cuba, Hawaii and Puerto Rico, 1938

(Source: American Potash Inst., Inc.)

	Short Tons. K_2O Agricultural Potash	Chemical Potash
Muriate		
60 per cent	267,130	14,903
50	120,659	.....
30	7,492	.....
25	1,990	.....
20	16,373	.....
14	117	.....
Sulphate	40,052	682
S.P.M.	4,827	.....
Totals	458,640	15,585

materials approaching the recent market requirements of the country. In this connection it must not be forgotten that of the total consumption a significant part of the potash is typically in the form of manure salts or other low-grade material, mainly imported. Therefore, if the domestic refinery capacity for muriate *and sulphate* is increased as expected, it will not be necessary for fertilizer companies materially to increase their consumption of low-grade potash materials in order to continue to supply all of the potash which American agriculture can afford to buy. By 1941, even assuming only partial restoration of imports, all fertilizer makers will probably be able to use either high concentration muriate or low-grade potash salts at will, because the supply of both types will be adequate. In no case is there any difficulty anticipated in getting a sufficient supply of pure materials for chemical uses.

All potassium sulphate has until lately been imported; and interruption of foreign supply appeared ominous for those needing that chemical. Most of the anticipated difficulties have not arisen. In the first place, two of the major American producers of chloride immediately began conversion of some muriate to sulphate. More than expected stocks of sulphate were discovered on hand in this country, and a careful analysis of the fertilizer users' need discloses that not much more than half of the sulphate used in fertilizers was actually necessary, or even more desirable than chloride.

Sulphate has a definite advantage on tobacco. But on most other crops for which it has been used, one can do the job just as well with an equivalent quantity of muriate. The farmers of Florida alone commonly have taken about a third of all sulphate for crops of this sort. A changeover of much or all of this would mean that American supplies of sulphate are nearly

adequate already, and several firms in position to convert muriate to sulphate are in readiness to carry out that conversion on any scale necessary to meet users' desires.

In a similar manner, American producers are arranging to supply ample high-grade muriate for use in manufacture of other potassium chemicals. Several American firms have stepped in promptly and have already begun (or are preparing to undertake) manufacture of all the needed chlorate, caustic, nitrate, carbonate, and other potassium chemicals required. The fact that there has been a negligible fluctuation in the market prices on most of these chemicals shows that even users are satisfied with the situation and prospects.

As soon as all of these domestic adjustments have been completed, it is expected that American producers of potash will be able to resume export. The Japanese market has been in the past one of the most profitable. It is likely to be reached again by American producers in 1941, if not in the late months of 1940. Because of transport costs and difficulties it is not so likely that American sales to Scandinavian countries will be resumed soon. But unless some unexpected development should make possible greater-than-expected export from continental Europe during the coming calendar year, there is every reason to believe that the American potash industry will be stabilized on a level more or less comparable with the total American requirement for fertilizer and chemical need. There is no bragging about this self-sufficiency; but a great deal of satisfaction is found among both producers and users in the fact that such status can be achieved if European conditions make it necessary.

Lead and Zinc Pigments and Zinc Salts Sold by Domestic Manufacturers in the United States (short tons)

	1938	1939
Basic lead sulphate or sublimed lead	[1] 5,801	[1] 5,800
Red lead	30,183	37,200
Orange mineral	127	130
Litharge	68,711	87,100
White lead:		
Dry	[2] 29,813	29,100
In oil [3]	70,400	70,400
Zinc oxide	79,129	114,700
Leaded zinc oxide	38,216	44,100
Lithopone	125,746	137,500
Zinc sulphate	7,757	10,600

[1] Exclusive of basic lead sulphate used for the manufacture of leaded zinc oxide which is included in tonnages shown for that pigment.
[2] Revised figures.
[3] Weight of white lead only.
Source: U. S. Bureau of Mines.

INCREASED ACTIVITY IN PIGMENTS

SUMMARY: ***Pigments were benefited by the improvement in all lines of industry. Interest among white pigments continued to be centered on the titanium group. The prices are being steadily reduced which partially accounts for the increased business. Sales of red lead and litharge were higher than in any year since 1929; those of zinc oxide were about equal to 1937.***

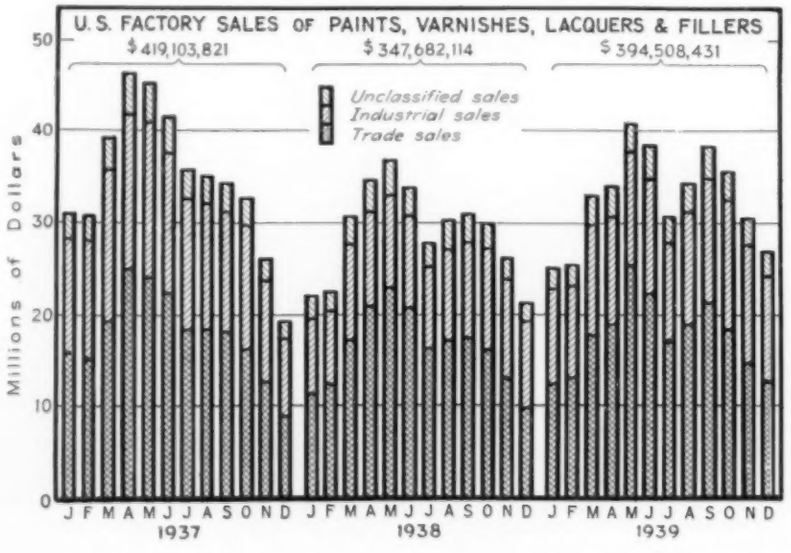
INCREASED ACTIVITY in all lines of industry including the paint, paper, floor covering, rubber and other important consumers of pigments resulted in a good year for these materials.

Titanium pigments continued to be the center of interest for they are making the greatest strides. The final months of the year saw all plants operating at capacity. Production for the year 1939 approached 165,000 tons. During the year one of the largest paint manufacturers completed and put in successful operation a pilot plant using a recently developed process. The price of titanium dioxide was again reduced; its current price is 13 cents per lb.

Naturally, the upward trend in general business was reflected in the demand for zinc pigments, and the consumption of zinc oxides and zinc sulphides according to the American Zinc Institute. Further developments in paint formulation, chiefly from the standpoint of hiding power per dollar, also accounted for additional business for the high-hiding zinc sulphide pigments as a result of many replacements of competitive pigments. Improvements in all other industries consuming zinc pigments resulted in a proportionate increase in the demand for these products. In particular, the rubber industry is finding many new advantages in improved zinc sulphide pigments for use in white rubber products. The rubber and ceramic industries were introduced to a new pelleted type of zinc oxide during the year that has just closed.

Sales of lead and zinc pigments in 1939 on the whole made a good showing in comparison with 1938, according to preliminary estimates of the U. S. Bureau of Mines. Sales of red lead and litharge were higher than in any other year since 1929; those of zinc oxide were about equal to the 1937 rate and, with the exception of 1936, were higher than in any other year since 1930; those of leaded zinc oxide established a new high record rate; and those of zinc sulphate approximately duplicated the record rate of 1937.

Of the lead pigments, total white lead sales were relatively unchanged from 1938, dry white lead sales having declined slightly. Sales of red lead were 23 per cent higher than in 1938



and of litharge were 27 per cent above. The total for basic lead sulphate was unchanged from the previous year. The increasingly large quantities of basic lead sulphate manufactured for use in the production of leaded zinc oxide are excluded from the totals shown for this product in order to avoid duplication of lead tonnages in reporting statistics for leaded zinc oxide.

Leaded zinc oxide sales were the highest ever reported, being 15 per cent over 1938 and 9 per cent above the previous record rate maintained in 1936 and 1937. Zinc oxide gained 45 per cent over 1938, the highest increase reported for pigments or salts, and was relatively the same in 1937. Except for 1936, sales of zinc oxide in 1939 and 1937 were the largest since 1930.

Zinc sulphate sales in 1939 were at about the record rate of 1937. Incomplete statistics covering zinc chloride indicate a notable advance in 1939 following a precipitous drop in 1938.

The most important items in foreign trade in lead and zinc pigments for the first 11 months of 1939 (12 months for 1938 shown in parentheses) were as follows: Exports of white lead (dry and in oil) amounted to 1,876 (1,411) short tons, of litharge were 1,966 (1,694) tons, of red lead were 1,161 (806) tons. Imports of lithopone during the same period totaled 2,641 (3,932) tons, of zinc oxide (dry and in oil) 1,480 (645). Exports of lithopone amounted to 4,106 (1,734) tons and zinc oxide to 2,964 (1,163) tons. Figures of imports and exports are obtained from records of the Bureau of Foreign and Domestic Commerce.

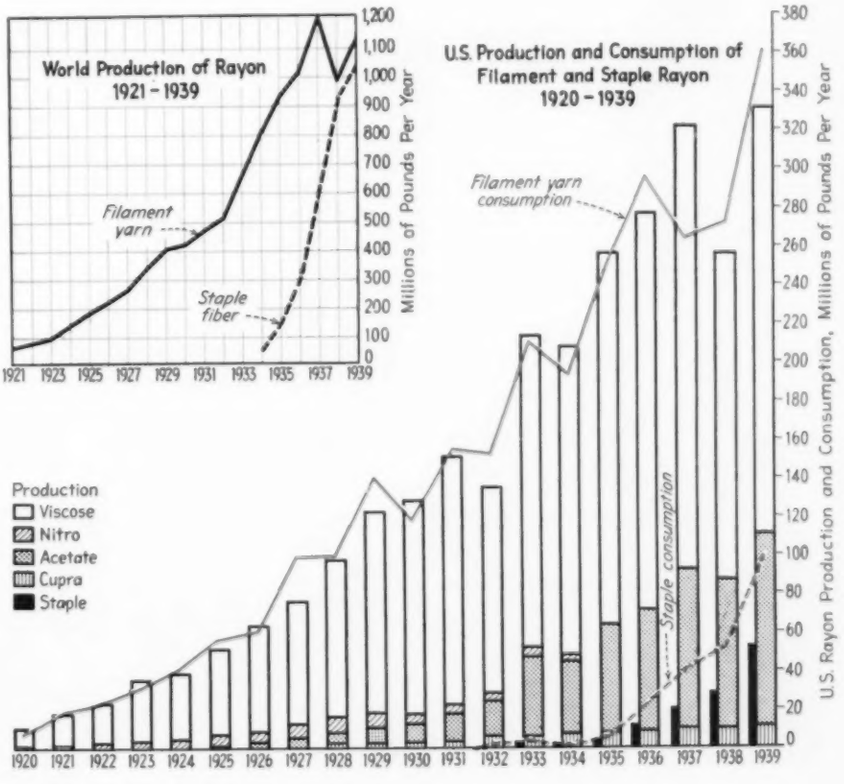
SYNTHETIC FIBERS

SUMMARY: *Synthetic yarn production established a new record to the extent of about 3 per cent in the field of filaments, and 78 per cent for staple fibers. Consumption of filaments exceeded previous highs by 22 per cent, however, and of staple, by 88 per cent. Acetate continued its steady increase in percentage of the total, and new non-cellulose-derived yarns went into commercial production for the first time.*

IT HAS long since become a commonplace that a year of increased production in the rayon industry is hardly news. Only when the man bites the dog, and rayon falls off for a period, is it a really newsworthy event. A long succession of new records, broken by declines only twice in 20 years or so that rayon has been a real factor on the American scene, has inured us completely to surprise at another new record, even such a one as was set up by this ever-growing industry in 1939.

According to the *Rayon Organon*, in which the industry's official statistics are reported, filament yarn production for 1939, placed at 331,200,000 lb., was only about 3 per cent above the 1937 record, although nearly 25 per cent ahead of 1938. Consumption, on the other hand, hit the tremendous peak of 362,375,000 lb., nearly 22 per cent larger than the earlier peak consumption during 1936. And this does not include staple fiber which in the last five years has suddenly spurted into prominence despite the private opinions still held by many experts that "staple will never amount to anything." Staple production, estimated at 53,000,000 lb., plus imports sufficient to make up a total of 100,000,000 lb. available for consumption, was the record of this fiber in 1939. Calling this last figure 100 per cent, then earlier staple years may be rated as 53 per cent in 1938, 41 per cent in 1937, 21 per cent in 1936, and 6 per cent in 1935. While apparent staple consumption was 21.6 per cent of all synthetic fibers in 1939, it amounted to but 2.3 per cent in 1935.

Another important development of 1939 lay in the fact that viscose filament yarn production decreased below the peak year of 1937 by nearly 4 per cent whereas acetate, the runner-up in total tonnage, nevertheless continued its rapid overtaking of viscose, with a 22 per cent gain over 1937. *Rayon Organon* estimates total viscose plus cuprammonium production at 230,950,000 lb. in 1939 (of which we believe 10–11,000,000 lb. was cupra) and acetate at 100,250,000 lb. Of the total estimated staple production of 53,000,000 lb. in 1939, we venture the guess that about 43,000,000 lb. was viscose, 10,000,000 lb. was acetate. Rayon stocks at the end of the year were estimated to have fallen to the low level of 6,400,000 lb., compared with 39,500,000 lb. in 1938.



More interest and speculation about synthetic fibers derived from materials other than cellulose was current in 1939 than ever before. DuPont's nylon, a thermoplastic polyamide of protein-like structure, finally went into production at the new $10,000,000 plant at Seaford, Del. Operation is being speeded up gradually and is expected to reach a point permitting regular marketing of nylon hosiery about May 15. American Viscose Corp. announced that spinning of Vinyon yarn has been put on a production basis at its acetate plant at Meadville, Pa., and that this vinyl derivative produced by Carbide & Carbon Chemicals Corp. is being used for industrial fabrics and may soon be available in other textiles, apparel and hosiery. A certain amount of experimental work has continued on casein fibers, and reports indicate other developmental efforts with soybean protein fibers and also zein filaments derived from corn. A yarn made of vinylidene chloride is now on the market in coarser counts and experimental use of a chlorinated rubber compound has been carried out.

Among the cellulose derivatives, further progress has been made in increasing tenacity and elasticity. Stretched acetate and various grades of stretch-spun viscose are now on the market, some with tensile strengths as high as five to six times those usual for ordinary grades of product.

Rayon Production and Imports, 1921–1939

	Thousands of Pounds		
	U. S.* Production	U. S.† Import Balance	World* Production
1921	18,000	3,276	65,000
1922	26,000	2,116	80,000
1923	35,000	3,029	97,000
1924	38,750	1,954	141,000
1925	52,200	5,293	185,000
1926	62,575	8,945	219,000
1927	75,050	14,633	267,000
1928	97,700	11,948	345,000
1929	121,399†	14,832	404,000
1930	127,333†	5,995	417,000
1931	150,879†	1,490	470,000
1932	134,670†	−456	509,000
1933	213,498†	−176	660,000
1934	208,321†	−2,432	799,589
1935	257,557†	−2,193	932,780
1936	277,626†	−1,558	1,022,000†
1937	321,681†	−525	1,199,000†
1938	257,916†	−1,194	990,000†
1939	331,200†	−1,700	1,125,000†

*From *Textile World* except as noted: does not include staple.

† From *Rayon Organon*. Does not include staple which is estimated at 350,000 lb. in 1930; 880,000 lb. in 1931; 1,100,000 lb. in 1932; 2,100,000 lb. in 1933; 2,200,000 lb. in 1934; 4,600,000 lb. in 1935; 12,300,000 lb. in 1936; 20,244,000 in 1937; 29,861,000 lb. in 1938; and 53,000,000 lb. in 1939. World staple estimated at 6,100,000 lb. in 1930; 52,700,000 in 1934; 139,900,000 lb. in 1935; 299,000,000 lb. in 1936; 619,000,000 lb. in 1937; 958,000,000 lb. in 1938; and 1,025,000,000 lb. in 1939. Import balance does not include staple; minus sign indicates net exports; staple imports 12,721,000 lb. in 1936; 20,614,000 lb. in 1937; 23,197,000 lb. in 1938; and 47,000,000 lb. (est.) in 1939.

Plastics Continue to Advance

SUMMARY: *The spectacular rise of this young industry is attracting attention from everywhere. The past year witnessed an important growth in volume of production and a tendency toward lower prices, particularly for the newer resins. There has been an increase in the amount used for established applications. In addition resins have found many new uses.*

PRODUCTION of cellulose plastic products last year showed increases in all lines over 1938, it has been reported by the Bureau of the Census. Production of nitrocellulose sheets totaled 9,551,548 lb. in 1939 compared with 6,616,787 lb. the previous year, an increase of 44 per cent. The rod production totaled 3,001,397 lb. last year compared with 2,237,395 lb. in 1938, a 34 per cent increase. A total of 820,227 lb. of nitrocellulose tubes was manufactured in 1939, which was an increase of 29 per cent. The reporting manufacturers consumed 3,476,226 lb. of nitro-cellulose sheets, rods and tubes in their own plants during the past year compared with 2,653,413 lb. in 1938.

A total production of 9,140,907 lb. of cellulose acetate sheets, rods and tubes in 1939 compared with 6,830,506 lb. in 1938, an increase of 34 per cent. The cellulose acetate molding compositions produced last year amounted to 11,654,928 lb. compared with 7,394,291 lb. in 1938, a 57 per cent improvement.

Hercules Powder Co., which entered the field three years ago, has on two occasions doubled the capacity of its plant. The most recent expansion program increased capacity to over 10,000,000 lb. a year. Hercules is now the second largest manufacturer of cellulose acetate for plastic applications.

During the year this company developed a water- and heat-resistant type of cellulose acetate which it is selling in flake form. This new form of acetate has molding characteristics similar to the standard material. It is finding use for refrigerator parts, automobile panels, bathroom fixtures, tooth brushes and the like.

As is shown by the large increase in the volume of cellulose acetate for moldings the demand for this plastic continues to improve. Much of this popularity is due to its suitability for injection molding. And each year the developments in the injection molding machine make it possible to mold larger and larger objects of cellulose acetate. In 1939, about 35 per cent of safety glass was made with cellulose acetate and 65 per cent with vinyl resin. The trend towards the latter is expected to continue.

The current price on cellulose acetate molding powder in granular form ranges between 52 and 46 cents per lb. according to color and quantity. These prices represent a decrease of 3 cents a lb. in all quantity classifications, compared with the schedule previously in effect.

Cellulose acetate butyrate developed over recent years by the Hercules Powder Co. and the Tennessee Eastman Corp., is making progress. Its low moisture absorption and resistance to varying conditions of humidity make it particularly satisfactory for use in applications subject to outdoor exposure and in applications subject to conditions of high humidity such as interior refrigerator parts. A recently developed use for this cellulose ester is tooth brush handles injection molded displacing handles machined from nitrocellulose blanks.

This plastic is now available in several degrees of flow for molding by compression and injection. The price of the cellulose acetate butyrate in lots of 1,000 to 5,000 lb. is 44 cents to 46 cents per lb. and in lots of 5,000 lb. or more 43 cents to 45 cents per lb.

Ethyl cellulose production facilities were expanded during the year to meet the increasing demand for this material. It is in demand as a coating for paper, for tipping cigarettes, as a textile size and other applications. The ethyl cellulose also is used for moldings. Hercules and Dow Chemical Co. are the domestic makers of this material The Advance Solvents and Chemical Corp. has been importing it.

Methyl cellulose sold for some time by Hercules and recently by Dow is regularly supplied in four viscosities: low, medium, high and extra high. This plastic is a water-soluble ether with a wide range of application,

particularly in the manufacture of paper, textiles, cosmetics and food products.

In the neighborhood of 4,000,000 lb. of polystyrene resins were produced last year. The principal source of supply of raw materials is Dow, while the polystyrene resins are available from Bakelite Corp. and Monsanto Chemical Co. The colored molding resins sells on a made-to-order basis demand a price of 58 cents per lb., in large quantities. The clear molding resin sells at a price of 52 cents per lb.

A thermoplastic material suitable for injection molding, polystyrene has a number of unusual properties. Made from water-clear base materials, it produces a molding compound capable of extreme clarity in finished pieces. It is moisture and alcohol resistant and also resistant to acids and alkalis. Dimensional stability under all conditions and high strength factor at low temperatures have made polystyrene popular for use in molded refrigerator parts. It first achieved wide notice due to its high dielectric strength.

Vinyl resins are produced by Carbide & Carbon Chemicals Corp., E. I. du Pont de Nemours & Co., and Shawinigan Resins Corp. (jointly owned subsidiary of Monsanto and Shawinigan Chemicals, Ltd.). Shawinigan Resins supplies Monsanto for its production of safety glass plastic, and in addition, markets vinyl resins for other uses.

Due principally to increased use of the resin for the interlayer material in safety glass the total production for the industry in 1939 doubled what it was in 1938. January 1, the prices on this group of resins were again reduced. The copolymer of vinyl chloride and vinyl acetate in large lots, was reduced from 55 cents to 48 cents per lb. The polyvinyl acetate was reduced from 45 cents to 40 cents per lb. and the polyvinyl chloride was reduced from 55 cents to 48 cents per lb. While the polyvinyl butyral (used in making safety glass interlayer) was reduced from over $2 to $1.25 per lb.

But safety glass is only one of many applications for these versatile resins. Other typical uses are: containers; coating for food containers, such as beer cans; electrical transcription records; adhesive; combs; impregnated fabrics, such as raincoats and shower curtains.

Acrylic resins produced principally by du Pont, and Robin and Haas Co., continued their growth and expansion into new fields. The resin's resistance to atmospheric conditions and shattering attracted considerable use by the airplane industry for windshields and cockpit enclosures. Denture blanks made by plasticizing methyl methacrylate polymers with the monomeric material yielded dentures of extraordinarily good quality. The optical properties of methyl methacrylate resulted in its use in various types of lenses and magnifying glasses. Based on its ease of fabrication, strength and eye appeal, the acrylic resins made strides into the field of home furnishings and interior decoration. Expansion also occurred in many of its former fields of applications such as, automobile parts, reflectors, signs, display pictures and instruments.

The prices of the acrylic resins in sheet, rod, and tube forms, varies according to the finish, color, form, quality and other conditions. Molding powder prices remain at about 85 cents per lb.

Phenolic resins were active in 1939. The molding resins (including filler) produced amounted to 54,000,000 lb. An additional 30,000,000 lb. of phenolic resins were used for impregnating, and all other applications. Prices for the molding materials remained unchanged during the year.

Several important changes in the ownership of large producers of these resins occurred recently. In August, 1939, Union Carbide and Carbon Corp. acquired all the assets of Bakelite, and in May Monsanto Chemical Co. purchased Resinox Corp., which was said to have been the third largest manufacturer of phenolic plastic molding compounds. The former owners were Commercial Solvents Corp. and Corn Products Refining Co.

The cast phenolic resin division of the industry made progress during the past year. Total production of cast phenolic resins in 1939 was about and possible slightly beyond 6,000,000 lb. There has been a slight upward trend in prices in the last six months.

Catalin Corp. remains the dominating factor in the industry. Licensees are Bakelite, Monsanto, Marblette, Joanite and Knoedler. The A. Knoedler Co., Lancaster, Pa., became a licensee during the last year.

Laminations of paper impregnated with the liquid resin are used for doors of refrigerators, venetian

United States Production of Cellulose Plastics

(Source: Bureau of Census)

	1933	1935	1937	Number of Establishments, by States, 1937
Nitrocellulose (pyroxylin):				
Number of establishments	12	13	11	Conn. 1; Mass. 4 N. J. 4; N. Y. 2
Total production not including finished articles, pounds	12,945,556	16,299,519	18,122,788	
Made and consumed in same establishments, pounds	2,849,523	2,958,859	3,271,971	
Produced for sale —				
Pounds	10,096,033	13,340,660	14,850,817	
Value	$7,799,283	$10,682,358	$12,526,206	
Finished articles of nitrocellulose (pyroxylin) made in producing establishments in Chemicals Not Elsewhere Classified industry, value	$5,020,356	$5,116,420	$5,390,313	
Cellulose acetate:				
Number of establishments	5	6	6	Mass. 1; N. J. 3; N. Y. 1; Tenn. 1
Pounds	2,874,819	10,395,290	18,923,663	
Value	$2,245,543	$7,986,489	$12,199,744	

Synthetic Resins; United States Production and Sales, 1938

Source: U. S. Tariff Commission

Resin Coal-Tar	Production	Sales: Quantity	Sales: Value	Unit Value
Alkyd:				
Maleic anhydride	3,432,887	2,978,718	$634,935	$0.21
Phthalic anhydride	37,563,840	21,931,783	4,467,466	.20
Tar acids:				
Cresol or cresylic acid	5,284,895	3,882,988	561,432	.14
Phenol:				
For casting	4,807,671	4,651,991	1,896,425	.41
For molding	13,487,681	12,787,051	2,189,600	.17
For other uses	17,658,391	17,484,415	2,939,971	.17
Xylenols	329,927	.....	.....	.....
Xylenols and cresols	2,396,273	.....	.....	.....
Total coal-tar resins	106,923,244	84,763,503	15,810,538	.19
Non-coal-tar				
Urea	8,249,900	7,467,782	3,312,678	.44
Total non-coal-tar resins	23,435,408	17,064,685	7,061,436	.41

shades, table tops and advertising displays. Other important uses for this type of resin that are on the increase are brush backs and the illuminated parts of coin record machines. The latter are made by slush molding.

Urea-formaldehyde resin production had a very successful year. The molding composition produced amounted to 14,000,000 lb. Another million pounds of the solution of resin was used for lamination,' cements, textiles and other applications. Present prices for urea resins in granular form are from 27½ cents to 35 cents per lb. in quantity. The liquid resins sell at 22 cents to 24 cents per lb. The urea resins are being used for electrical insulation, closures, white buttons, housings, tableware, lighting fixtures and containers.

Lignin plastics made headway recently. Masonite Corp. was the first to enter the field, but recently the Marathon Chemical Co. has come into the market with a somewhat similar type of plastic. Marathon expects ultimately to offer lignin core and surface sheets for laminating, lignin molding compositions for positive, inpection and impact molding, and special lignin resins for coating, impregnating and adhesives. Of these the lignin laminating sheets are in commercial production and the molding compositions and special resins are in semi-commercial production.

SYNTHETIC ORGANIC CHEMICALS

SUMMARY: *Another year and another new record is the story of organic chemicals for 1939. Outstripping average increases for all chemical industry, makers of synthetics chalked up gains of 25 and 30 per cent in the production of many items. Non-coal-tars especially recorded production in excess of 1937 levels. Business resulting directly from the war was not great but there were some changes in foreign trade. Prices were steady.*

WHEN BUSINESS is bad, executives are inclined to watch closely all data on trends in production, in consumption and in markets. They generally know just *how bad* business was and they state the facts rather boldly. But when business is good, vigilance is relaxed and data are not so readily available.

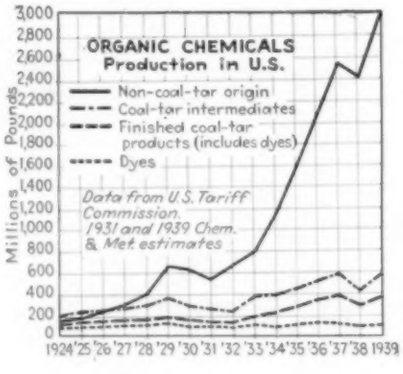
The latter is the situation for synthetic organic chemicals as we look back over 1939. Everyone says business was good; few know *how good*. No figures are available—neither official, semi-official, nor unofficial. Few producers will even venture a guess; they say they are too busy trying to fill orders received months ago. But from our own preliminary estimates on certain commodities we believe that 1939 production of all synthetic organic chemicals outstripped 1938 by 25 to 30 per cent, thereby reaching another all-time high. Coal-tar crudes were up 35 per cent, alcohol solvents up about 20 per cent, acetic acid and derivatives more than 25 per cent.

New products were few. In the early part of the year, manufacturers were wary because of the international situation; the latter part they were too busy filling orders on present products to market new ones.

Undoubtedly imports were lighter, exports heavier. There was much talk of selling to South American and Oriental markets formerly outlets for Germany. Some such selling actually took place. Some items formerly imported became export items, e.g., acetic acid and anhydride.

Surprisingly enough the direct effect of the war was slight. During its opening days there was a scurry by consumers of such items as phenol and naphthalene to fill depleted stocks, but the discovery that domestic productive capacity for these materials was more than adequate quickly brought the markets back to normal levels.

New plant construction was fair in amount but not greatly diversified. Plants for the production of ethylene glycol were built or are being built by duPont (Belle, W. Va.) and by U. S. Industrial Chemicals, Inc. Also Carbide & Carbon increased its capacity for making this commodity at South Charleston. Barrett Co. and General Plastics built synthetic phenol plants; and Commercial Solvents is building a new plant at Peoria, Ill., to make nitroparaffines. DuPont's new $11,000,000 nylon plant, part of which went into production Dec. 15, will require large quantities of intermediates to be made in new facilities at Belle, W. Va.



Acetic Acid

Once more acetic acid and its derivatives captured the spotlight as they came back from their 1938 decline to register an all-time high both in production and consumption. *Chem. & Met.'s* estimates placed production of acetic acid and derivatives at roughly 215,000,000 lb. (basis 100 per cent acetic) as compared with 157,000,000 lb. for 1938. Consumption of the acid and its derivatives amounted to 211,-

U. S. Production and Sales of Organic Chemicals

(Production and sales in thousands of pounds, value in thousands of dollars)

	Average 1925–1930	1935	1936	1937	1938	Percent Decline 1938 from 1937
Coal-tar intermediates;						
Production	267,492	436,656	509,706	575,893	401,943	30.2
Sales	109,133	190,917	223,119	242,194	171,514	29.2
Sales value	22,408	26,074	31,806	35,639	26,090	26.8
Finished coal-tar products; [1]						
Production	138,078	272,728	336,348	373,063	276,387	25.9
Sales	133,964	230,381	287,276	315,742	245,340	22.3
Sales value	65,027	98,792	120,765	128,736	104,372	18.9
Dyes; [2]						
Production	94,003	101,933	119,523	122,245	81,759	33.1
Sales	92,207	97,954	117,573	118,046	87,803	25.6
Sales value	39,428	51,488	63,686	64,613	53,096	17.8
Non-coal-tar Synthetics; [3]						
Production	379,972	1,591,896	2,041,455	2,529,650	2,409,456	4.7
Sales	264,006	791,760	1,034,921	1,168,149	1,121,608	4.0
Sales value	44,499	86,334	105,832	119,420	116,014	2.8

[1] Includes dyes, medicinals, flavors and perfume materials, resins, color lakes, rubber chemicals, and miscellaneous.
[2] Totals for 1937 and 1938 not comparable with other years because of changes in classification.
[3] Includes non-coal-tar medicinals, flavors and perfume materials, resins and miscellaneous.

000,000 lb. as compared with 163,000,000 in 1938 and 206,000,000 in 1937. As predicted last year, imports again dropped off from 6⅓ million pounds to 1½ million pounds. Unexpectedly, both acetic acid and acetic anhydride exports exceeded imports. In addition there were increases in the amount of butyl and amyl acetates usually exported. Total exports on a 100 per cent acetic acid basis were in excess of 5,000,000 lb.

Chem. & Met. Estimates for Acetic Acid and Derivatives (Basis 100% Acetic Acid)

(Millions of Pounds)

	1937	1938	1939
Production	177.2	157.0	215.0
Imports	31.7	6.3	1.5
Exports	2.7	3.0	5.5
Apparent Domestic Consumption	206.2	160.3	211.0

The figure of 215,000,000 lb. for production was made up of about 50,000,000 lb. from the hardwood distillation industry and 165,000,000 lb. by other methods. Much of this latter figure was synthetic acetic acid, but a very significant amount was composed of acetic acid derivatives made directly without intermediate recovery of the acid itself.

Wood distillers recovered somewhat from their 1938 slump, but still produced a relatively small proportion of the total amount of acetic acid. Their 50,000,000 lb. was divided between direct recovery and acetate of lime in a ratio a little better than 2 to 1. Something over 14,000,000 lb. was made as acetate of lime. The amount by direct recovery (36,000,000 lb. in 1939) will probably increase in 1940 because one large wood distillation unit, shut down for plant alterations during the past year, is expected to produce substantial quantities of acid this year.

Three new synthetic acid plants commenced operations in 1939—two of them producing for their own consumption and a third making synthetic acetic acid for sale. All of these were mentioned in last year's report—two in a speculative sense and one as a plant under construction. One of these plants located in West Virginia was understood to have made substantial quantities of acid in 1939. One large rayon company which formerly imported a large share of its acetic acid began secondary production of acetic anhydride from used acid. Their primary anhydride was purchased from domestic producers.

The third new acid plant was an installation of Commercial Solvents Corp., at Agnew, Calif. The plant makes acetic acid by a new process from ethyl alcohol. Probably this process will become more widely used in 1940. This company is the first to produce acetic acid on the Pacific Coast, but it is understood that others are prepared to do so should the market become large enough.

As a matter of interest your reporter plotted the production of acetic anhydride and cellulose acetate side by side. As evidenced by the accompanying chart, the ratio of anhydride to acetate is fairly constant for all years except 1938 where anhydride dropped more than acetate. Inasmuch as varying amounts of anhydride from ½ to 1 lb. are required per pound of acetate, it is obvious that most of the anhydride made goes to this market.

Dye production was up 25 per cent or more from 1938 levels. With textiles, the dye industry suffered a bad year in 1938, but had a good year in 1939. Textiles, unlike many other commodities, had good business all year and not just a spurt in the last six months.

Turning for a moment to 1938, the last year for which U. S. Tariff Commission data are available, we find that 1938 was not a good year for synthetic organic chemicals. The industry suffered its first serious setback in its 25 years of rapid ascension. Production of coal-tar intermediates declined 30.2 per cent from 1937 levels and finished coal-tar products declined 25.9 per cent. Included in the latter item is a 33.1 per cent drop in dye production.

However, production of synthetic organic chemicals of non-coal-tar origin was fairly steady with a decrease of only 4.7 per cent. Actual data from the U. S. Tariff Commission are presented on the opposite page.

Year after year it has been pointed out in these columns that the commercial manufacture of complex organic chemicals in substantially pure form has become enormous in volume. To emphasize that point we have selected from the U.S.T.C. report all those materials of which there was a production of 1,000,000 lb. or more in 1938 and for which production data were publishable.

Production in Pounds of Selected Organic Chemicals, 1938

Coal-tar intermediates

1-amino-8 naphthol-3:6 disulphonic acid (H acid)	2,515,842
Aniline oil	26,745,862
Cresols, ortho, meta and para	11,403,429
o-Dichlorobenzene	3,290,355
p-Dichlorobenzene	13,061,206
Dimethylaniline	2,739,289
Dinitrobenzene	1,312,482
Dinitrochlorobenzene	4,965,771
Maleic acid and anhydride	1,538,648
Naphthalene, solidifying 79°C. or above (refined, flake):	38,259,167
From domestic crude	21,991,677
From imported crude	16,267,490
α-Naphthylamine	2,155,334
1-Naphthylamine-3:6:8 trisulphonic acid	3,260,315
Nitrobenzene	36,934,140
Phenol	44,547,798

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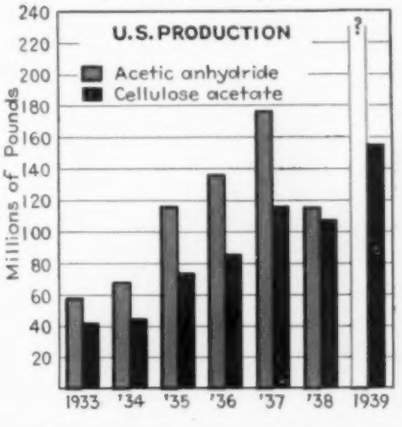
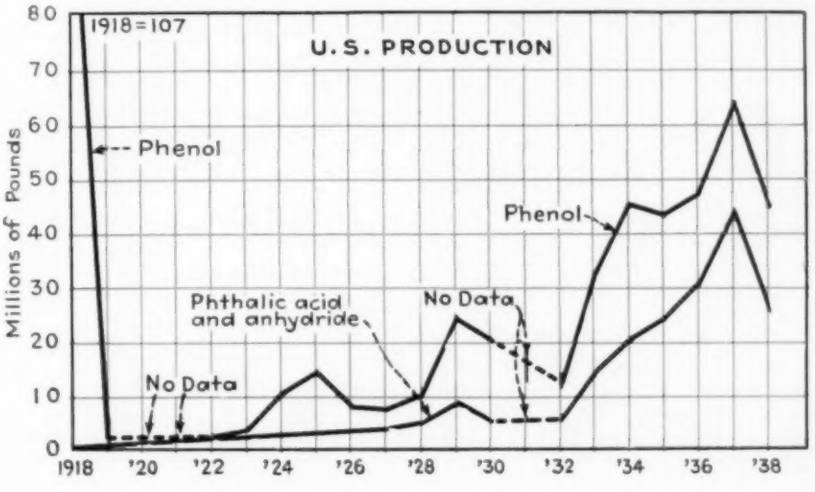


Right—U. S. Tariff Commission data for acetic anhydride and *Chem. & Met.* estimates for cellulose acetate are shown side by side

Below—Synthetic resins account for the rapid growth in phenol and phthalic anhydride production



Phenylglycine, sodium salt	4,205,347
Phthalic acid and anhydride	27,650,270
Sulphonilic acid and salt	1,503,149
Dyes	
Chrome blue black U (*Aso*)	1,003,200
Acid black 10 B (*Aso*)	1,342,004
Developed black BHN (*Diazo*)	1,603,401
Direct black EW (*Triazo*)	6,302,835
Sulphur black (*Sulphide*)	7,640,041
Sulphur blue (*Sulphide*)	1,589,407
Sulphur brown (*Sulphide*)	1,076,770
Synthetic Indigo (20%)	11,000,829
Color lakes and toners	
Peacock Blue	1,207,592
Lithol	2,031,975
Medicinals	
Acetylsalicylic acid (Aspirin)	3,896,066
Salicylic acid	3,330,237
Flavors and Perfume Materials	
Methyl salicylate	1,287,481
Miscellaneous Chemicals	
Hydroquinol	1,246,671
Dibutyl phthalate	4,206,475
Acetic acid (100%)	97,478,563
Acetic anhydride	114,835,504
Amyl acetate	5,828,497
Amyl alcohol	9,096,977
Butyl acetate	55,792,217
Butyl alcohol	81,304,789
Carbon tetrachloride	77,975,057
Chloroform (tech. and USP)	2,159,933
Citric acid, refined (fermentation)	10,277,234
Diacetone alcohol	2,382,481
Ethyl acetate	55,725,726
Isopropyl alcohol	141,081,915
Lactic acid, edible (100%)	1,292,216
Methyl chloride (100%)	3,064,227
Oxalic acid	9,194,738
Sulphated fatty alcohols, acids, etc.	7,668,458

In addition to these, there were a number of important materials for which data were not publishable because production was not evenly divided among three producers. These included: synthetic camphor, crotonaldehyde, synthetic ethyl alcohol, ethyl chloride, ethylene dibromide, ethylene dichloride, ethylene glycol, formaldehyde, synthetic methanol, and tetraethyl lead. Bearing in mind that 1938 was a poor year, the above list is an impressive one.

Phenol and phthalic anhydride are typical of the industry. As shown on the graph (see page 81) their production has risen from practically nothing to considerable quantities principally through the development of a new use—synthetic resins.

During the war phenol was used to a considerable extent in the manufacture of explosives; hence the large production in 1918. However, when the war was over, consumption dropped to practically nothing and synthetic plants were forced to close down. Until 1923 most of the production was from tar, but with the jump in consumption caused by resin production, synthetic plants resumed operations. Now the bulk of the phenol (75-80 per cent) is synthetic.

Research Expenditures

For the first time since 1934, research expenditures of the synthetic organic chemical industry were reported by the U. S. Tariff Commission. The 1938 report placed the net cost of research at $10,449,000 for 1938 as compared with $7,630,000 in 1934. For both years this expenditure amounted to 4.3 per cent of all synthetic organic chemical sales. Inasmuch as net cost is determined by deducting from gross cost the credits for salable products obtained in the course of research, a great deal more than the amount reported must have been spent for scientific investigations in this field.

The industry employed 1,603 technically trained research workers in 1938 at an average annual salary of $3,328. This compared with $2,864 average salary in 1934. Data are summarized in the accompanying table.

Research Expenditures by the Synthetic Organic Chemical Industry in 1938

	Coal-Tar Chemicals	Non-Coal-Tar Chemicals	Coal-Tar & N-C-T Chem. Jointly [1]	Total
Number of employees	756	655	192	1,603
Salaries (in thousands)	$2,761	$1,952	$622	$5,335
Net cost of research (in thousands)	$5,005	$3,934	$1,510	$10,449
Total sales (in thousands)	$130,462	$116,014	[2]	$246,476

[1] Reported by companies unable to separate expenditures into coal-tar and non-coal-tar.
[2] No comparable sales classification.

GAS AND COAL PRODUCTS

SUMMARY: *Gas utilities report increased revenue from sales of both natural and manufactured gas, the gains being 7.8 and 2.1 per cent. Commercial and house-heating applications were largely responsible for the increases. Reports of 1939 byproduct and beehive coke production show increases of 35 and nearly 50 percent over 1938; a response to the 1939 demand for steel. Output of coke and other coal products established a new all-time high in December. Many new ovens were put into operation.*

THE GAS UTILITIES continued their gain in business during 1939, serving an all-time record number of consumers, approximately 17,500,000 customers in cities and towns having a total population of 82,000,000. Revenue from sale of gas was approximately 5.2 per cent greater than the preceding year, the gain in natural gas income being 7.8 per cent as compared with 2.1 per cent gain for the manufactured gas division of the industry.

The accompanying tables and charts show the magnitude of the two divisions of the business as compared with previous years. It is notable that the consumption of manufactured gas for household purposes, except house heating, is continuing to decline, but that this loss in business is more than offset by the increased house heating. The industrial and commercial sales also have gained steadily for a number of years, now exceeding, in both natural and manufactured divisions of the industry, the requirements of boom years.

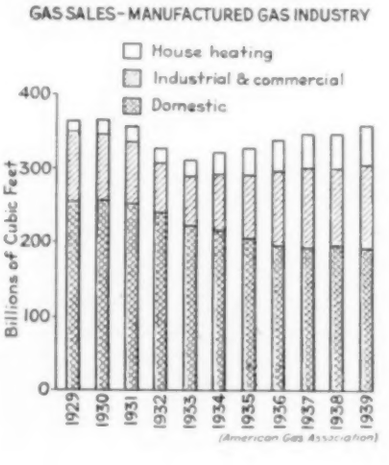
Preliminary estimates of American Gas Association indicate a total production of natural gas during 1939 of approximately 2.2 trillion cubic feet. Of outstanding importance among new users is the central station of the electric industry which is believed to have used 192 billion cubic feet, or 9 per cent of the total production

Natural Gas in 1938

(Data from Bureau of Mines)

Production	2,295 billion cu. ft.
Avg. value at wells	4.9 c. per M cu. ft.
Avg. value at point of use	21.8 c. per M cu. ft.

Consumption	Billions cu. ft.	Avg. value at point of use
Household and commercial	482	68.3 c.
In producing field	660	4.5 c.
Carbon black mfgr	325	8.9 c.
Petroleum refinery fuel	110	16.7 c.
Electric power plants	170	
Other industrial	548	



last year. Use of gas for central house heating and for air conditioning in both the household and commercial fields continues to increase. The industry is also giving more attention to new applications of gas as a fuel for process industry.

Coke and Byproducts—Production of byproduct coke in 1939 was about 43 million tons, or 35 per cent more than in 1938. Beehive coke production this same year was nearly double that of the preceding year, being approximately 1.4 million tons. The increased activity in the two divisions of the coke industry was, of course, only a normal response to the 1939 demand for steel.

The output of coke and other coal products at byproduct ovens in December established a new all-time high. The coke production was 4,718,000 tons, exceeding the previous high month's record established in May, 1929, by nearly 60,000 tons.

During the past year three by-

Coke-Oven Tar—United States, 1938

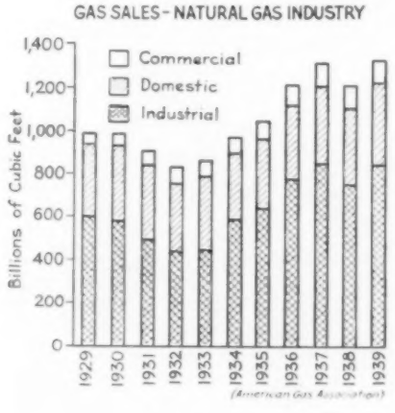
(Data From the U. S. Bureau of Mines)

Total produced	419,579,649 gal.
Used in open hearth or other affiliated plants	25,162,853 gal.
Used by producer as boiler fuel	771,949 gal.
Used otherwise	6,360,298 gal.
Sold for refining into tar products	264,471,374 gal.
Sold for fuel	37,849,648 gal.
Total value of sales	$14,904,501
Average value	4.9c. per gal.
Yield of tar per ton of coal coked	9.27 gal.

Statistics of the Gas Industry

(Source: Estimates of American Gas Association)

MANUFACTURED GAS	1939	1938	Per Cent Change
Sales (in M cu. ft.)			
Domestic	193,830,000	197,052,000	− 1.6
House Heating	55,537,000	47,918,000	+15.9
Commercial	55,599,000	54,032,000	+ 2.9
Industrial	55,645,000	47,398,000	+17.4
Miscellaneous	1,979,000	2,244,000	.....
Total	362,590,000	348,644,000	+ 4.0
Revenue (Dollars)			
Domestic	$257,523,000	$258,357,000	− 0.3
House Heating	36,026,000	31,030,000	+16.1
Commercial	47,419,000	46,718,000	+ 1.5
Industrial	25,803,000	22,855,000	+12.9
Miscellaneous	1,293,000	1,534,000	.....
Total	$368,064,000	$360,494,000	+ 2.1
NATURAL GAS			
Sales (in M cu. ft.)			
Domestic (Incl. House Heating)	376,613,000	352,964,000	+ 6.7
Commercial	110,541,000	100,951,000	+ 9.5
Industrial	655,359,000	589,398,000	+11.2
Electric Generation	192,144,000	170,039,000	+13.0
Total	1,334,687,000	1,213,352,000	+10.0
Revenue (Dollars)			
Domestic (Incl. House Heating)	$256,732,000	$242,658,000	+ 5.8
Commercial	50,500,000	47,240,000	+ 6.9
Industrial and Electric Generation	141,841,000	126,682,000	+12.0
Total	$449,073,000	$416,580,000	+7.8



Value of Byproducts and of Coke, Including Breeze, per Ton of Coke Produced in the United States, 1915-1938

(Data from Bureau of Mines)

Product	1915	1920	1925	1930	1936	1937 [1]	1938
Ammonia and compounds	$0.70	$1.16	$0.69	$0.502	$0.287	$0.326	$0.380
Light oil and its derivatives (including naphthalene)	0.52	0.61	0.54	0.527	0.438	0.443	0.423
Surplus gas sold or used	0.61	1.05	1.54	1.754	1.589	1.483	1.907
Tar sold	0.25	0.21	0.30	0.344	0.344	0.365	0.471
Miscellaneous products	0.03	0.01	....	0.061	0.039	0.066	0.094
	2.11	3.04	3.07	3.188	2.697	2.683	3.275
Tar used, not sold	[2]	0.22	0.29	0.312	0.197	0.223	0.183
Breeze produced	[3]	0.14	0.22	0.208	0.163	0.162	0.189
Total value of byproducts including those not sold	2.19	3.40	3.58	3.708	3.057	3.068	3.647
Value of coke produced	3.45	10.15	5.28	4.836	5.064	[4] 5.026	[4] 5.164
Total value of coke and byproducts	5.64	13.55	8.86	8.544	8.121	8.094	8.811

[1] Revised. [2] Included in tar sold. [3] Estimate included in total. [4] The average receipts per ton of coke sold during these years were $6.111 in 1937 and $6.002 in 1938.

Byproducts Obtained from Coke-Oven Operations in the United States in 1938[1]

(Exclusive of screenings or breeze)

Product	Unit	Production	Sales — Quantity	Sales — Value — Total	Sales — Value — Aver.
Tar	Gal	419,579,649	302,321,022	$14,904,501	$0.049
Ammonia:					
Sulphate	Lb.	873,863,077	916,619,707	10,712,947	.012
Ammonia liquor (NH_3 content)	Lb.	40,725,570	41,452,920	1,330,304	.032
		.....	.....	12,043,251	.....
Sulphate equivalent of all forms	Lb.	1,036,765,357	1,082,431,387	.....	.....
Gas:					
Used under boilers, etc	M cu. ft.	[2] 499,692,522	19,039,377	1,205,661	.063
Used in steel or affiliated plants	M cu. ft.		143,598,923	14,813,680	.103
Distributed through city mains	M cu. ft.		141,700,942	42,023,525	.297
Sold for industrial use	M cu. ft.		18,671,749	2,322,117	.124
		.....	323,010,991	60,364,983	.187
Light oil and derivatives:					
Crude light oil	Gal.	[3] 123,559,610	9,558,969	805,807	.084
Benzol, crude and refined	Gal.	17,744,657	17,175,742	2,317,420	.135
Motor benzol	Gal.	56,349,589	55,675,583	5,373,407	.097
Toluol, crude and refined	Gal.	13,021,080	12,884,734	2,819,431	.219
Solvent naphtha	Gal.	3,706,258	3,462,836	633,330	.183
Xylol	Gal.	2,900,243	2,732,697	677,311	.248
Other light oil products	Gal.	5,450,045	3,617,721	319,777	.088
		[4] 99,171,872	105,108,282	12,946,483	.123
Naphthalene, crude and refined	Lb.	24,943,014	25,456,400	437,654	.017
Tar derivatives:					
Creosote oil, distillate as such	Gal.	12,986,940	9,784,554	1,079,392	.110
Creosote oil in coal-tar solution	Gal.	773,669	120,679	21,722	.180
Pitch of tar	Net tons	183,692	3,595	38,701	10.765
Other tar derivatives	.....	.....	.....	1,243,363	.....
Phenol	Gal.	107,778	98,373	41,986	.427
Sodium phenolate	Gal.	180,347	181,360	12,911	.071
Light carbolic oils	Gal.	1,993,930	1,986,673	185,083	.093
Sulphur	Lb.	3,469,094	3,534,515	105,377	.030
Other products [5]	.....	.....	.....	246,442	.....
Value of all byproducts sold	.....	.....	.....	[6] 103,671,849	.....

[1] Includes products of tar distillation conducted by coke-oven operators under same corporate name, except, however, phenol, and other tar acids produced at Clairton, Pa.
[2] Includes gas wasted and gas used for heating retorts.
[3] Refined on the premises to make the derived products shown, 117,248,545 gallons.
[4] Total gallons of derived products.
[5] Ammonia thiocyanate, asphalt paint, carbolates, cyanogen sludge, calcium ferro-cyanide, pyridine oil, sodium carbolate, sodium prussiate, spent soda solution, and vented vapors.
[6] Exclusive of the value of breeze production, which in 1938 amounted to $5,995,267.

product coke plants resumed operation and 165 new byproduct ovens were first charged. At the year end, 84 byproduct plants were in operation, all but five of them recovering ammonia but only 56 producing light oil or such refined products as benzol. The accompanying table indicates preliminary estimates of the yields of these and other byproducts during 1939.

Gas	665,000,000 M cu. ft.
Tar	550,000,000 gal.
Ammonium sulphate	1,150,000,000 lb.
Ammonia liquor (NH_3 content)	50,000,000 lb.
Crude light oil	165,000,000 gal.

Average Yield of Coke and Byproducts per Net Ton of Coal Charged in Byproduct Ovens in the United States, 1915-1938

(Data from Bureau of Mines)

Product	Unit	1915	1920	1925	1930	1936	1937	1938
Coke	Lb.	1,440	1,395	1,398	1,380	1,409	1,414	1,399
Tar	Gal.	7.1	8.2	8.4	9.20	8.86	8.67	9.27
Ammonium sulphate or equivalent	Lb.	20.1	21.4	22.4	23.47	[1] 22.14	[1] 21.84	[1] 23.36
Light oil	Gal.	1.5	[1] 2.7	[1] 2.9	[1] 3.06	[1] 2.91	[1] 2.86	[1] 2.99
Gas;								
Total	M cu. ft.	11.0	10.8	11.2	11.05	11.06	10.89	11.04
Surplus sold or used	M cu. ft.	4.3	5.2	6.3	6.75	6.85	6.66	7.14
Firing ovens	M cu. ft.	6.3	5.4	4.7	4.05	4.02	4.03	3.74
Wasted	M cu. ft.	0.4	0.2	0.2	0.25	0.19	0.20	0.16

[1] Average for plants recovering this commodity.

Average Receipts, in Cents, per Unit of Coke-Oven Byproducts Sold, 1913-1938

(Data from Bureau of Mines)

Year	Tar	Sulphate	Surplus gas	Benzol refined	Motor Benzol	Toluol refined	Solvent naphtha [1]	Naphthalene Crude	Naphthalene Refined
	Gal.	Lb.	M cu. ft.	Gal.	Gal.	Gal.	Gal.	Lb.	Lb.
1913	2.5	3.1	8.8	[2] 27.0	[3]	[2] 29.0	[2] 25.0	[3]	[3]
1915	2.6	2.8	10.2	56.8	[4]	245.0	24.0	[5] 10.0	
1920	3.7	4.3	14.0	26.0	22.7	30.0	18.1	2.7	6.1
1925	4.9	2.3	17.0	22.4	16.6	26.1	20.2	1.0	2.5
1930	4.9	1.6	17.9	[5] 17.6	14.1	[5] 29.9	20.5	[5] 1.2	
1936	4.3	1.0	16.3	[5] 14.0	9.0	[5] 27.4	22.2	[5] 1.6	
1937	4.8	1.1	15.8	[5] 13.2	[6] 9.1	[5] 26.5	22.8	[5] 2.0	
1938	4.9	1.2	18.7	[5] 13.5	9.7	[5] 21.9	21.2	[5] 1.7	

[1] Includes xylol. [2] Trade quotations, New York Market: used to avoid disclosing individual operators' reports. [3] No data. [4] Not reported during the war. [5] Crude and refined not separated. [6] Revised.

ALCOHOL AND SOLVENTS

SUMMARY: ***Volume of solvents business last year was up about 20 per cent but dollar value did not increase proportionally. Market passed from extreme of large supplies and unstable values to excess of demand over supply and rising trend for prices with heavy call for export shipments.***

PRODUCTION of ethyl alcohol for the twelve months of 1939 amounted to 221,617,741 proof gallons which was a gain of more than 15 per cent over the 192,678,160 proof gallons made in 1938. Tax-paid withdrawal of 22,837,300 proof gallons was about 8.7 per cent below the 1938 total but tax-free withdrawals ran ahead of those for the preceding year with the result that producers stocks were reduced by more than 6,000,000 proof gallons during the period.

Denaturing plants operated more actively in the last calendar year and, based on monthly reports issued by the Bureau of Internal Revenue, their output consisted of 14,747,106 wine gallons of completely denatured and 99,173,588 wine gallons of specially denatured. For 1938 the totals were 18,211,582 and 74,692,337 wine gallons respectively. A few years ago, the greater part of denatured production was credited to completely denatured grades but for some time the trend has been reversing and last year specially denatured accounted for more than 87 per cent of production. The decline in production and consumption of completely denatured last year, no doubt was accelerated by the removal of restrictions on the use of specially denatured for the anti-freeze trade and considerable quantities of the latter are said to have gone into anti-freeze.

The market for denatured alcohol was one of extremes. During the first quarter of the year supplies of Cuban and Puerto Rican molasses were plentiful and as consuming demand for alcohol was of moderate proportions, producers who were supplied with low priced molasses began a more active sales campaign with the result that prices were lowered and the advance which had been put into effect on Dec. 15, 1938 was not operative by the end of January. The low prices which prevailed over the first quarter brought about attempts to raise quotations for second quarter deliveries but competitive influences were too strong to bring this about.

About the middle of the year business began to improve and paradoxically this further complicated matters because some producers who had been selling at below-cost levels were called upon to increase deliveries which meant increasing losses correspondingly. However, no price adjustment was made and these unfavorable conditions remained until September when the European situation became a predominating factor in

Ethyl Alcohol Production and Distribution

	1,000 pr. gal. 1939	1,000 pr. gal. 1938
Produced	221,618	192,678
Withdrawn, tax-paid	22,837	24,825
Withdrawn, tax-free		
For denaturation	199,770	160,808
For hospitals, etc	1,980	1,895
U. S. and Divisions	1,188	975
For export	325	140
In Puerto Rico	795	794
Stocks, Dec. 31	14,614	20,894

Alcohol Denatured

	1,000 wi. gal.	1,000 wi. gal.
Produced	14,747	18,212
Completely denatured	99,174	92,904
Specially denatured		
Producers stocks, Dec. 31		
Completely denatured	427	547
Specially denatured	859	606
Bonded dealers stocks		
Specially denatured	306	316

Materials Used in Manufacture of Ethyl Alcohol

	Fiscal Years 1937-38	1938-39
Molasses, gal.	162,557,843	158,908,347
Grain:		
Corn, lb.	189,235,346	156,650,225
Malt, lb.	26,832,102	21,131,972
Rye, lb.	5,386,117	2,398,507
Other, lb.	363,695	157,836
Ethyl sulphate, gal.	26,577,150	35,388,995
Sulphite liquor, gal.	.....	24,949,950
Pineapple juice, gal.	2,007,339	1,593,687
Crude alcohols mixture, gal.	.....	1,227,112
Potatoes, lb.	.....	743,411
Manioca meal, lb.	156,296	.....
Cellulose pulp and chemical mixtures, lb.	.....	149,024
Miscellaneous, lb.	16,350	130,605

the market. Prior to the outbreak of hostilities some of the European countries had been purchasing stocks of molasses and when demand for alcohol began to rise in September, it was found that stocks of molasses in primary points had been greatly reduced. At the same time some of the vessels ordinarily used in transporting molasses were taken out of that service and freight rates advanced to the equivalent of one-half a cent a gallon. Some of the smaller alcohol producers who had only small reserves of molasses withdrew spot quotations for alcohol and limited contract customers to the unexpended portion of their contracts.

The move to limit amounts available to contract holders spread to some of the larger producers and buyers whose requirements were not covered had difficulty placing orders and in cases where they were successful found that deliveries were delayed owing to the inability of producers to turn out supplies equal to their commitments. Difficulty also was experienced by some sellers in obtaining containers as a sold up position existed in that field. Hence the latter part of the year was a complete reversal of conditions found in the earlier part and a sellers market had succeeded the buyers market which had ruled for a long period.

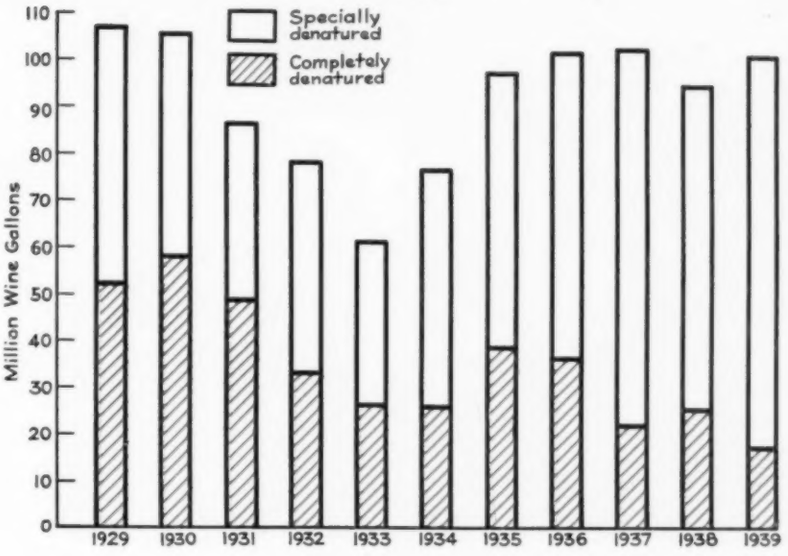
Competition in the anti-freeze trade started early in the year and the original price schedule of 29½¢ in drums was not adhered to so that a large part of this business was reported to have been done around the 25¢ level. In the latter part of the year quotations for completely denatured anti-freeze were withdrawn but the jobbing and dealer trade had been pretty well covered at the low prices and the most encouraging results of the year came not from the business transacted but rather from the improved prospects for the new year.

One of the most striking developments in the solvents field last year was the complete reversal in the position of acetone. In 1938 production had run ahead of consuming needs and while some producers were sold up, others had accumulated large stocks which precipitated price-cutting sales pressure. Toward the close of that year export buying from the Far East became active and the large amounts shipped out of the country did much to improve the market. Contracts for 1939 delivery, however, were taken at unchanged figures and in consequence sellers continued to operate on small profit margins. The shifting of one of the largest contracts from a synthetic to a fermentation producer had given evidence that there had been no weakness in competitive selling during the contract season. With the improved demand for acetone, particularly from the textile trade, the market appeared to have worked into a position where higher prices might be realized but no change followed. Around the middle of the year, the possibility of even larger call for supplies became evident and some of the producers attempted to advance quotations but this step was opposed by other producers and again no change was made for the quarter.

With the outbreak of war, events worked quickly toward a revision in sales schedules. Domestic consumers stepped up delivery calls and export inquiries began to pour into the market. The Far East and South America which had been receiving supplies from Germany negotiated for large amounts and some of the European countries added to the export movement. This sudden expansion in demand both at home and from abroad put considerable pressure on producers who by that time were carrying very little reserve stocks. As this buying interest increased rather than diminished an actual shortage developed which became more pronounced when foreign buyers started bidding frantically for supplies with total disregard for costs. The market then saw the unusual situation of domestic contract holders receiving acetone at 4½¢ per lb. delivered and acetone for export being sold at 12¢ per lb. f.a.s. if and when deliveries could be made.

Production of Completely and Specially Denatured Alcohol

Fiscal Years



During 1939, 449,974 cords of hardwood were carbonized, that is, about 8.8 per cent more than in the preceding year, but less than 80 per cent of that carbonized in 1937. The output of crude methanol was 4,659,589 gallons, equivalent to approximately 3,960,000 gallons of refined methanol. The production of synthetic methanol during the same year was 34,255,699 gallons. Thus, the wood methanol represented only a trifle more than 11 per cent of the total production.

During the past two years production of gray acetate of lime has been slightly less than consumption. Thus, stocks have fallen off materially, as indicated by the following estimates for the hardwood distillation industry:

	1938	1939
	(millions of pounds)	
Producers stocks, Jan. 1.	16.06	4.03
Production	17.12	18.0
Apparent consumption...	29.15	19.0

While production of crude methanol in 1939 did not come up to the 1937 total it increased more than 11 per cent over the figure for 1938. Values for this product were well maintained throughout the year. Changes in denaturing formulas whereby wood distillation methanol may be used in denaturing ethyl alcohol, aided in the volume of distribution and was a stabilizing factor on prices. Producers also kept output at a level in proportion to consuming requirements and the sound statistical position helped to steady the market.

On the other hand, activities at synthetic methanol plants not only exceeded the rate maintained in 1937 but established an all-time high for the in-

dustry, with a gain of more than 31 per cent over 1938 and about 7 per cent over 1937. Although synthetic methanol was turned out in quantities larger than ever before, present plant capacity was not operated to the full and leading producers are reported to be planning still higher outputs for the present year, unless there is a change in industrial conditions.

The consumer structure of the industry was changed during the year by the purchase by one of the large producers of its chief competitor. As large amounts of methanol are used in the manufacture of synthetic resins, a good part of production is consumed where made since two of the largest methanol producers also are prominent in the resin industry.

Production of Methanol

1939	Synthetic gal.	Crude gal.
January	2,462,884	351,814
February	2,267,339	336,157
March	2,406,564	364,500
April	2,276,385	389,423
May	1,778,581	354,415
June	2,295,288	343,992
July	2,495,394	377,755
August	2,678,983	359,594
September	2,639,934	404,876
October	4,158,161	463,420
November	4,611,707	479,622
December	4,184,479	434,021
Total	34,255,699	4,659,580
1938		
January	2,896,894	458,347
February	2,290,609	408,930
March	2,343,828	432,800
April	1,975,999	314,664
May	1,860,400	330,875
June	1,629,570	293,091
July	1,449,607	309,219
August	1,897,847	281,988
September	1,929,655	303,225
October	2,294,532	335,380
November	2,617,979	344,328
December	2,844,249	357,249
Total	26,031,169	4,170,096

Higher alcohol and acetates were subject to the conditions which were common to the solvents industry with the market passing through varying stages of activity and price fluctuations. Butyl alcohol was stocked rather heavily in the early part of the year and the weight of offerings resulted in a lowering of prices which was extended to butyl acetate which sold at the all-time low of 7¢ per lb. and some business was reported to have gone through under that figure. As the year advanced changes were for the better both in trading activity and price advances. Fermentation producers late in the year were affected by the higher prices asked for molasses and as this concurred with the more active trading movement, offerings quickly were reduced until ability to make deliveries was sorely tested. Contract holders gave shipping orders for their full complement and apparently deliveries will not be able to catch up with shipping orders until well along in the present quarter.

The position of butyl products had a stimulating effect on sales of secondary butyl and isobutyl acetates as well as amyl and the latter products likewise closed the year with sellers having difficulty in making deliveries promptly.

Methyl ethyl ketone stands out in the solvents list as one of the selections which maintained a firm price position throughout the year. It shared the common statistical position of other solvents at the end of the year and will command advanced prices for 1940 delivery.

A review of the solvents industry as a whole presents a more encouraging picture than has been possible in recent years. To project probabilities far into the future would require a prophetic knowledge of what is to take place in foreign countries. Temporarily, European countries are reported to be covered on their solvent requirements and may not show much interest in our markets in the next few months. The Far East is not so well supplied particularly Japan with its current use for military operations. The European situation also could change with startling suddenness if the war should assume real proportions. The outlook at home is for continued good business and if this is supplemented by the full possibility of foreign business, a shortage of supplies will be almost a certainty even though fermentation solvents may be helped by completing arrangements to bring in molasses by large barges. The domestic industry entered the year with every producing plant taxed to capacity. The relatively low prices at which contracts were accepted means that profit margins are low and do not encourage plant expansion to take care of an increased consuming demand which may or may not continue over a protracted period.

SALT CAKE

SUMMARY: *Record production of sulphate pulp increased consuming demand for salt cake last year and the elimination of imports from Germany in the closing months brought about a shortage with a consequent running up of delivered prices. Synthetic salt cake and substitute materials helped to relieve the stringency but supplies were subnormal in the closing months.*

THE remarkable rise in manufacture of sulphate pulp in this country in the last few years has established salt cake as one of the important chemicals. Shipments of salt cake have gained in tonnage and as the growth of pulp production is expected to show further rises in the future, the possibility of expansion in consumption seemed to be limited only by the ability of consumers to locate supplies. Over the first eight months of last year the salt cake market had proceeded in an orderly and routine way with the enlarged call for deliveries being met by a combination of domestic and imported material.

When normal conditions were upset by the existence of economic changes in Europe, salt cake was one of the first chemicals to be affected. Many of the pulp mills in this country were dependent on Germany for their supply of cake. Shipments from Germany were suspended from September forward. It was necessary for these mills to look elsewhere for suppliers and while producers of chemical and natural salt cake increased productive operations, their efforts could not make up entirely for the drop in arrivals of imported cake. Pulp mills also were affected by price considerations, for domestic cake commanded a price delivered at mills considerably above that for which their contract commitments called.

The use of salt cake in the glass and chemical industries has been diminishing and rise in its use has resulted wholly through the increase in pulp requirements. This increase came at a time when production of salt cake on the part of hydrochloric acid manufacturers was being reduced owing to changes in technology which permitted the making of the acid without any attendant production of salt cake. An offset to this condition has been found in enlarged production of acid with a larger yield of salt cake from the plants which have not changed

their process of manufacture. However, the supply of salt cake from that quarter was not as large as would have been the case if all acid producers were producers of cake.

In a survey carried out by the U. S. Tariff Commission, data were given for salt cake consumption by pulp mills and it was found that whereas only 106,233 tons were taken by mills in 1927 this had increased to 218,264 tons by 1935. Consumption of salt cake in the glass industry in 1925 was reported at 67,761 tons which dropped to 41,189 tons in 1935. In 1937 glass makers used 53,070 tons of salt cake but this increase over 1935 appears to have been the result of larger glass outputs rather than any relatively higher use of cake. Consumption of salt cake in the chemical industry has been largely confined to plants which were producers of the cake. Its use declined with the drop in production at acid plants and possibly because larger surpluses could be marketed as the outside consuming market was expanded. This may be illustrated by the fact that in 1919 chemical consumption was placed at 56,095 tons which had dropped to 27,830 tons in 1937.

As demand for salt cake increased for sulphate pulp manufacture consumers were forced into the import market and as mills generally are located near tide water, they found they were able to obtain attractive prices from outside sellers and the water freight rates gave them an advantage over domestic sellers when delivered costs were considered. Hence the sales market for cake was divided along geographical lines with foreign sellers monopolizing the southern and far-western portions and domestic sellers predominant in the eastern and mid-western fields. Germany held a commanding lead among the foreign suppliers and Germany was the country most directly affected in a shipping sense when the war began. Holders of contracts with German sellers, therefore, were not only forced into the open market when contract deliveries were suspended but also lost the freight advantage which was so important in delivered costs. Some of the southern mills which formerly obtained salt cake at a delivered price under $15 per ton found it necessary to pay as high as $23 a ton.

With limited possibilities for increasing salt cake in the chemical industry, greater attention was given to the market for natural salt cake and production from the latter source was called upon more extensively to fill the gap which the loss in imports had created. The development of natural deposits has been held back because of distance from consuming markets and the consequent handicap of high transportation costs. Supplies of natural cake are capable of being expanded sufficiently to free consumers from foreign dependence but only at a price and there is not much inducement to plan larger outputs if consuming markets are to be open only for a limited time.

Larger supplies of chrome cake were made available last year as a result of increased operations at bichromate plants and still further gains in output are indicated for the present year. Production of synthetic salt cake also got underway and contract deliveries will assume greater importance in the present quarter. The use of alkalis and sulphur mixtures likewise was resorted to last year and favorable reports have been heard regarding results. Some salt cake which was recovered at viscose rayon plants is said to have been shipped to pulp plants and a fairly large potential supply might be obtained from that source but the economic phases are not favorable.

In connection with the use of salt cake in pulp manufacture, it is of interest to note that cake consumption per ton of pulp has been declining. There is considerable difference in the various plants and also according to the various types of wood used. The survey made for 1935 showed uses of salt cake ranging from a minimum of 150 lb. per ton of pulp to a maximum of 479 lb., the average being 309 lb. Assuming that 275 lb. of salt cake was a fair average for last year, the total requirements for pulp would have reached 375,000 tons.

Chile possesses large deposits of natural salt cake and also can recover it as a byproduct in the production of sodium nitrate. In recent years Chile assumed some importance in the export trade and has been credited with annual production of close to 70,000 tons. The nitrate industry is regarded capable of recovering very large amounts each year if a satisfactory market could be found. The Bureau of Mines is authority for the statement that Chile shipped to this country 687 tons in 1936, 17,120 tons in 1937, and 26,079 tons in 1937. When supplies from Germany were cut off last year there was speculation about the possibility of Chile coming forward with offerings which would take the place of the anticipated German product. Official figures, however, are reported to have shown that Chile sent very little salt cake to this country last year and it will be interesting to see if the salt cake situation has influenced nitrate producers to increase production which may figure in our import trade in the present year.

OILS AND FATS

SUMMARY: *Domestic production of fats and oils set a new high at 8.4 billion lb. Record high soybean production and return to a lard surplus were largely responsible for this new figure. Prices were lowest since 1931-34, except for the drying oils. Dehydrated castor oil entered the field of drying oils as an outstanding competitor of tung oil. Continuous processes of refining, deodorization, hydrolysis and saponification continue to be perfected.*

THE largest production of domestic fats and oils on record occurred in 1939. A preliminary figure of 8.4 billion lbs. is given by Department of Agriculture statisticians. Increases in production of soybean oil, linseed oil, lard, tallow and grease more than offset the decreases noted in cottonseed oil, peanut oil and whale oil. Preliminary figures for factory production and consumption of all fats and oils in the United States for 1939 are given in Table I. Final figures are also shown for 1937 and 1938 for comparison. Apparent stocks on hand are also shown as of December 31.

Supply and demand resulted in very low prices for fats and oils in general during the year 1939. On the average, prices were the lowest since the four-year period 1931-1934.

Editor's Note: This section of our report was prepared by Gordon W. McBride, chemical engineer, 712 Jackson Place, Washington, D. C., and is the first of several articles on the economics and technology of the oil and fat industries which will appear in *Chem. & Met.* during 1940.

The drying oils opposed the trends, however, both in quantities available and in price.

Lard Surplus—The definite return to a lard surplus in the United States came in 1939, and this contributed in large measure to the low prices for the entire fats and oils structure. Exports of lard have also been declining for several years, with the result that the quantity formerly exported must now be absorbed at home.

There is no immediate prospect of relief as the pig crop of 1939 was larger than that of 1933, the former record-breaking year. Therefore lard production in 1940-41 will be considerably greater than that of 1939, which was in excess of domestic consumption. A continued low average price for all fats and oils is forecast for 1940.

Soybean Record—Production of soybeans in 1939 was approximately 87 million bu., setting a new high. This was 50 per cent more than in 1938, and nearly ten times the 1929 production. The oil equivalent of the 1939 crop is over 800 million lb., but a large portion of the beans are not crushed. Exports accounted for about one-sixth of the domestic production last year, nearly six times the export of 1938. Domestic consumption of soybean oil, principally in shortenings, is expected to show a considerable increase over 1938 when complete statistics are available.

Prejudice and Habit—For many years linseed oil has been the only paint oil of any consequence. Attempts to introduce any new paint oil have been necessarily slow because of reluctance to adopt a product which must have years of proving. Federal and state specifications for paint have also contributed to the rigidity of the situation. The length of time required to introduce a new vehicle into established specifications is well known. There is a natural inertia in persuading state and industry officials to break with the traditional custom of following Federal specifications.

Since a great quantity of paint is manufactured and sold under the Federal Government specifications, it is only natural that a new product would have to be well proved before it is permitted to compete on even terms. But paints made with soybean and other oils equally new to the paint field are now beginning to receive more serious attention. Tests are being made which apparently support the contentions of the manufacturers that linseed oil is not the only good paint oil.

That agriculture is meeting this challenge is seen from the fact that the domestic production of flaxseed for 1939 was approximately 20 million bu., well above the ten-year average of 12 million bu., and a marked increase over the 8 million bu. harvested in 1938.

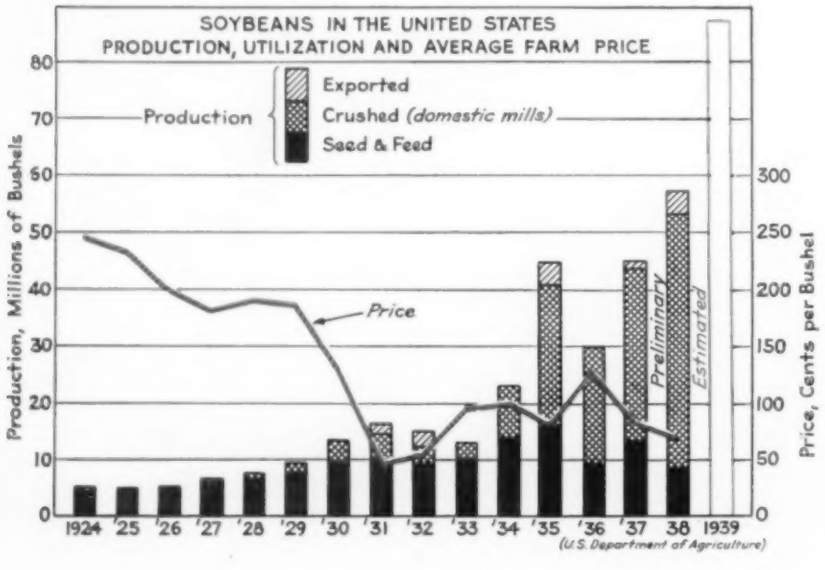
Tung Supply Curtailed—The supply of tung oil available for import into the United States has been seriously affected by the hostilities in the Orient. While production of tung oil in China is reported to be only slightly below normal, little of this oil is getting to the United States. Prices have risen accordingly, further stimulating domestic production. This is far from adequate to supply the demand, however, so the varnish makers have turned to other oils to replace the expensive and scarce tung. Oiticica oil has benefitted most by these circumstances, and real progress in use of modified soybean oil for paints and varnishes has also been stimulated.

Dehydrated Castor Oil—Another substitute for tung oil is a dehydrated castor oil, produced by catalytic distillation. Marked increase in production of this new product as a high quality varnish constituent was seen in 1939. The amount of dehydrated castor oil available apparently is limited only by the capacity of the equipment in this country and the quantity of castor beans that can be imported from Brazil. In the latter part of 1939 it was reported that the castor bean crop in Brazil would be slightly smaller this season than last. Efforts are being made, however, to secure as large a quantity as possible and plans for expansion of dehydrating equipment are going ahead. Experimental planting of newly developed strains of the castor plant in the southern states is continuing as a trend of possible industrial significance. The technologic factor in the conversion of this oil with no drying properties to an outstanding drying oil is worthy of note.

Food Oil Habits—The edible oils have perhaps been held in a rut. There has been some interchange between competing fats and oils, but in general the tendency has been to buy a particular oil because that is the oil that has been bought for years. Now there is a little more tendency to use whatever oil can be obtained at a favorable price, treating it as may be necessary to obtain the desired quality and properties in the finished product. Thus food manufacturers begin to get away from prejudice in favor of technology.

An interesting trend has been noticed in edible oils recently in regard to flavor. It has long been recognized that the American palate rejected Latin olive oils and Oriental soybean oils in favor of the bland, practically flavorless, refined cottonseed oil and refined corn oil. Campaigns are now apparent to sell the flavor as well as the food value of peanut oil and soybean oil.

Rancidity—The perpetual problem of preventing rancidity, especially in food products, appears to be nearing a solution of general importance. An article published in November (*Food Industries*, **12**, 626, 1939) discusses the advantages of the use of ascorbic acid (vitamin C) and related compounds as anti-oxidants in preventing rancidity. Fundamental



research is also being carried out by the U. S. Regional Soybean Industrial Products Laboratory. The method of attack has been to concentrate the natural anti-oxidants present in soybean oil to obtain a sufficient quantity for identification and tests. Preliminary results indicate that this material is related to vitamin E. Interesting results are being obtained and will be published shortly. Although these anti-oxidants seem to be related to vitamins, the soap man and other inedible fats and oils users who have rancidity problems will be no less ready to adopt them.

Any Fat for Soap—The soap man has long been a juggler of fats and oils, showing little regard for tradition. Each new oil that has come to his attention has been given critical examination and as wide use as possible. Of course, it has been easier for the soap man to do this because the ultimate destination of the fats and oils largely obscures their original character. As a result he has had a great many more oils with which to work than the edible products manufacturer.

Price vs. Quality—There is one important question that the fat and

Production Consumption and Stocks of Fats and Oils

(Data from Department of Commerce, Bureau of the Census)

	Production		Consumption		Factory and Warehouse Stocks		
	1939 Lb.	1938 Lb.	1939 Lb.	1938 Lb.	Dec. 31, 1939 Lb.	Dec. 31, 1938 Lb.	Dec. 31, 1937 Lb.
VEGETABLE OILS							
Cottonseed, crude	1,390,085,564	1,677,672,907	1,392,438,199	1,703,383,329	181,234,819	175,464,445	200,943,424
Cottonseed, refined	1,313,663,577	1,561,958,540	1,246,818,535	1,398,565,702	553,176,074	565,309,208	450,728,833
Peanut, virgin and crude	72,581,000	78,152,286	74,261,806	70,969,266	4,007,837	7,564,228	4,311,751
Peanut, refined	70,990,072	66,659,800	62,873,368	58,151,205	16,222,271	18,793,647	19,163,280
Coconut, crude	273,271,444	286,850,169	586,091,668	578,168,145	178,382,458	202,383,946	166,084,591
Coconut, refined	217,340,162	315,327,136	229,050,139	292,176,452	11,882,610	13,334,750	10,950,238
Corn, crude	150,555,463	136,729,481	150,262,956	144,405,729	20,358,310	14,725,017	8,912,826
Corn, refined	134,657,149	131,101,685	68,146,176	59,466,314	13,479,315	12,325,122	8,889,108
Soybean, crude	449,806,623	323,342,588	390,162,115	276,600,265	43,928,813	49,576,906	44,890,307
Soybean, refined	342,375,427	243,088,622	319,215,442	203,916,708	26,016,891	25,504,532	16,381,149
Olive, edible	.....	4,741,545	3,981,640	2,989,891	8,598,811	4,949,861	2,467,861
Olive, inedible	.....	2,505	5,508,654	4,247,543	3,255,272	861,904	1,697,385
Sulphur oil	.....	.....	19,366,835	15,378,050	14,484,553	12,419,521	8,547,083
Palm-kernel, crude	.....	.....	8,403,389	50,703,914	374,750	4,050,097	41,034,879
Palm-kernel, refined	4,623,429	18,284,719	6,769,999	19,542,694	649,950	2,263,095	787,595
Palm, crude	.....	.....	259,909,010	255,729,112	118,561,747	143,678,674	145,103,819
Palm, refined	113,813,678	123,473,912	122,987,073	120,895,240	13,713,161	18,759,219	9,169,530
Babassu, crude	71,380,600	29,502,633	67,384,595	29,524,991	5,912,885	1,462,820	2,753,544
Babassu, refined	28,152,107	19,564,825	23,960,787	22,507,677	290,629	277,700	432,503
Rapeseed	.....	.....	6,517,968	5,316,730	6,600,581	2,959,378	5,002,220
Linseed	564,507,734	440,614,136	345,198,291	298,481,423	142,643,286	141,803,031	191,483,128
China wood	.....	.....	91,092,102	87,415,084	31,556,115	61,188,828	48,655,853
Perilla	.....	.....	42,539,104	32,649,485	15,174,694	13,622,165	23,694,105
Castor	75,605,782	52,272,923	41,137,725	28,159,768	12,377,211	17,186,709	18,639,733
Sesame	.....	.....	2,268,359	7,567,761	169,281	205,440	5,484,841
All other	14,101,379	17,417,862	35,724,935	31,952,283	13,364,352	16,340,795	17,295,455
FISH OILS							
Cod and cod-liver	2,524,013	2,088,747	18,760,147	18,625,252	33,643,949	31,011,597	18,673,214
Other fish oils	208,265,222	188,309,367	203,266,745	134,708,504	167,007,797	146,160,069	106,461,896
Marine animal oils	25,937,725	58,286,746	94,393,022	70,664,323	44,503,463	82,272,603	91,306,225
ANIMAL FATS							
Lard, neutral	3,103,765	2,891,519	2,023,115	2,237,453	581,407	294,867	290,603
Lard, other edible	1,410,875,225	1,160,250,135	13,230,232	7,687,807	166,391,046	108,887,182	55,962,771
Tallow, edible	93,879,117	93,481,361	61,919,796	78,320,322	8,057,567	7,505,676	8,890,338
Tallow, inedible	601,056,792	517,285,875	878,437,318	764,041,171	240,643,003	194,947,216	195,998,384
Neat's-foot oil	5,040,825	4,119,682	5,691,624	4,757,080	1,660,233	1,297,946	1,826,435
GREASES							
White	74,775,643	54,462,389	51,966,184	37,902,986	15,053,278	10,561,769	9,995,956
Yellow	89,548,537	76,766,566	46,954,138	44,641,302	13,705,243	16,521,161	19,541,458
Brown	70,513,177	60,863,521	50,877,878	41,379,571	11,712,716	14,157,786	16,777,408
Bone	26,659,989	24,601,498	1,908,367	1,104,266	1,597,839	1,254,694	1,852,266
Tankage	49,038,681	42,474,363	5,171,271	6,303,028	3,101,556	2,701,378	4,639,055
Garbage or house	46,540,877	45,682,319	28,930,625	34,296,508	5,062,178	8,496,883	14,962,419
Wool	7,191,822	5,323,712	5,590,703	4,516,297	4,608,451	3,042,224	1,877,293
All other	16,047,380	17,284,413	19,350,492	12,622,807	5,474,701	4,689,289	5,151,260
OTHER PRODUCTS							
Shortening	1,390,915,010	1,514,027,820	1,354,255	1,335,680	56,620,648	55,662,426	46,031,230
Hydrogenated oils	819,949,868	722,624,913	768,331,370	668,761,113	27,296,723	24,455,118	22,468,217
Stearin, vegetable	95,887,326	85,617,049	92,094,219	79,335,034	7,554,536	11,752,699	5,612,068
Stearin, animal, edible	37,674,382	46,136,622	32,079,358	41,616,010	4,450,193	4,527,252	5,305,579
Stearin, animal, inedible	15,357,456	11,953,676	12,641,354	10,779,677	2,842,826	2,532,437	2,936,509
Oleo oil	75,860,075	88,346,062	12,942,488	14,234,942	6,550,685	5,954,054	6,350,683
Lard oil	22,444,537	22,887,970	11,677,047	8,993,105	4,598,253	8,274,450	6,452,482
Tallow oil	7,864,722	7,353,400	5,678,150	4,930,565	1,431,660	1,776,533	2,270,249
Fatty acids	127,296,511	131,732,383	109,442,546	115,572,745	10,367,828	9,601,480	7,436,425
Fatty acids, distilled	38,805,589	43,720,885	18,407,830	36,609,161	4,235,784	3,628,279	4,728,301
Red oil	48,657,460	33,174,810	34,321,688	25,132,283	6,647,840	7,715,434	9,514,870
Stearic acid	33,673,630	24,940,476	15,341,706	11,430,002	5,191,666	3,588,235	3,749,974
Glycerin, crude 80% basis	183,610,302	152,120,070	192,430,085	171,603,817	14,635,739	13,410,521	14,179,678
Glycerin, dynamite	65,528,366	43,613,526	35,049,367	27,467,560	25,062,409	22,170,245	16,709,903
Glycerin, chemically pure	86,950,963	91,326,551	26,506,383	21,309,144	36,445,992	47,593,535	29,852,887
Cottonseed foots, 50% basis	139,639,209	245,226,865	145,026,640	270,246,088	13,856,319	21,812,916	30,611,328
Cottonseed foots, distilled	49,414,575	60,288,299	42,875,543	49,137,072	3,457,917	4,482,319	4,469,506
Other vegetable oil foots, 50% basis	133,074,638	128,286,674	100,635,909	103,158,739	4,179,869	4,464,543	4,701,033
Other vegetable oil foots, distilled	516,437	1,403,452	488,070	1,650,371	493,690	656,386	23,017
Acidulated soap stock	66,007,095	123,210,223	93,795,104	100,761,095	33,810,329	56,626,447	36,919,965
Miscellaneous soap stock	2,216,347	1,162,704	6,127,342	2,992,608	572,762	1,770,439	334,537

oil manufacturer must always answer: Which is the more important factor in the buying of fats and oils, quantity or quality? For a given product it may be that the manufacturer is seeking only a particular fatty acid which is obtained in a naturally occurring oil. If a high-quality oil is needed for his process, he will be willing to pay a higher price for the prime-quality oil. If, on the other hand, a few per cent of free fatty acid is just the beginning of a reaction whereby the oil is soon completely split into fatty acid, then the lowest quality of the particular oil which he can get may be just as satisfactory. There is quite a spread between the prices of the best and the poorest grades of any given oil, often enough to make or break a process.

Fatty Acid Development—With the exception of the edible and the drying fats and oils, the technical consumer is interested primarily in the fatty acid part of the molecule. The soap man for instance is now more and more splitting his fats before saponifying them, recovering his glycerine from fatty acid splitting processes rather than from the soap kettle. Mixtures of fatty acids from a natural fat or oil are also being separated by methods similar to those used in the petroleum industry for separating fractional hydrocarbon components. By these means the saturated fatty acids are being separated from the unsaturated, and even the individual fatty acid is prepared for use as a chemical entity. Equipment and methods are being perfected for such splitting and separation, and the industrial fats and oils consumer is being educated in the new technique of their use.

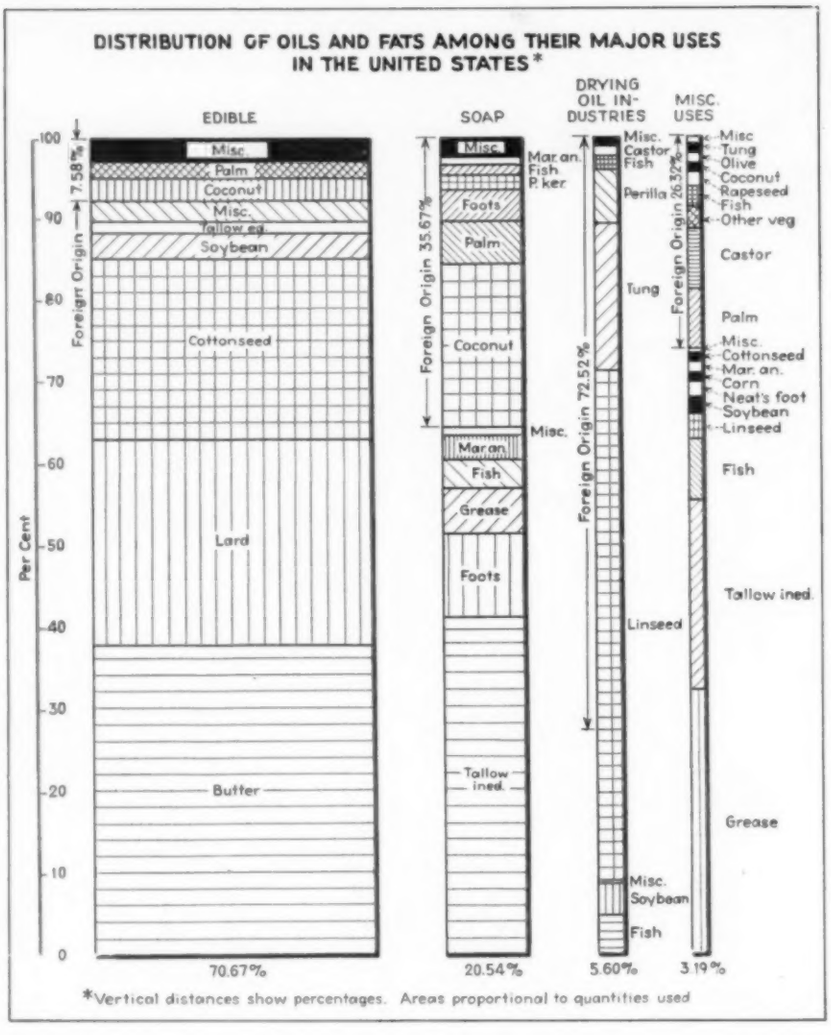
Refining Technique—During the past few years there has been much work done on the refining of vegetable oils. With the introduction of soybean oil into the domestic supply of industrial oils it was quickly found that existing refining methods were not satisfactory. Simple modifications of existing methods were attempted without much success. Eventually new refining methods were developed, based on the soybean oil peculiarities, with success not possible while merely attempting to modify existing refining methods. As a result soybean oil now is being refined satisfactorily and efficiently to produce high quality grades of oil.

In general, a continuous refining method has been found most practical. The crude oil and the refining caustic solution are proportioned through heaters and mixers and then separated by continuous centrifuging. The soap which forms in the refining process tends to dissolve in the oil and, unless completely removed, catalyzes the hydrolysis of the refined oil. At least two water washes have been found desirable to remove the last traces of soap from the refined oil. Finally the refined and washed oil is dried by flashing into a vacuum chamber at moderately elevated temperature.

Modifications of this new technique are now being adapted to the refining methods for other oils, notably cottonseed. This is an interesting example of how the process developed for a relatively new commodity has improved the technique in handling a long-established one.

Another of the new and interesting technical announcements in this field has been a method for the continuous deodorization of fats and oils. Better product quality is claimed, a result of lower refining temperatures and shorter times at elevated temperatures, and product uniformity is increased through automatic controls. Operating economy is also claimed in that less steam is required than for the typical batch process. Less water is needed, and efficient heat exchange results.

Fats and Oils Research—In connec-



This chart shows consumption of oils and fats in edible products exceeded all other uses of oils and fats. The paint maker is relatively more dependent on imported oils, although he imports less than the food manufacturer on a tonnage basis. The soap maker is largest importer of fats and oils, principally because of his need for coconut oil, essential for its lathering properties. The chart is based on reports issued by U. S. Bureau of the Census and U. S. Department of Agriculture, and it duplicates that appearing in "The Tariff on Animal and Vegetable Oils" published by the Brookings Institution

tion with the establishing of four Regional Research Laboratories of the Department of Agriculture, a survey was completed during 1939 summarizing all the research which is taking place in this country on fats and oils. This survey* includes research not only on all domestically produced fats and oils but also on those which are imported. A proposed fats and oils research program was outlined for the Department of Agriculture Regional Labs, representing the work thought most important by American industry. It is presented as part of this survey report and it should be studied carefully as it gives a preview of industrial utilization of fats and oils 25 years from now.

*Senate Doc. No. 65, 76th Congress, 1st Session, "Regional Research Laboratories, Department of Agriculture".

TURPENTINE AND ROSIN

SUMMARY: *Conservation program resulted in lowering production of naval stores but prices were weak and irregular until the latter part of the year when demand improved both for home consumption and for export.*

PRODUCTION of spirts of turpentine in the six months from April through September, which constitutes the first half of the naval stores year, amounted to 354,702 bbl. as compared with 463.370 bbl. for the corresponding period of 1938. The conservation program which provided payments to producers who joined in the movement to restrict output was an important factor in cutting down the output of naval stores products. If production over the second half of the fiscal year should proceed along normal lines the prospective output of gum turpentine would reach about 375,000 bbl. and of wood turpentine about 170.000 bbl. This total of 545,000 bbl. would represent a decline of more than 20 per cent from the 709,218 bbl. produced in the preceding fiscal year.

Consumption of turpentine in the April-September period last year was placed at 256.295 bbl. with exports amounting to 131,125 bbl. For the same period in 1938, domestic consumption was figured at 224,717 bbl. and exports at 110,123 bbl. The larger movement to consumers last year combined with larger shipments to foreign markets resulted in a larger total disappearance at a time when production was under curtailment, hence there was a drop in carryover stocks with inventories on Sept. 30 amounting to 293,269 bbl. as contrasted with 354,981 bbl. on the same day of 1938.

Definite data for September forward are not yet available but trade reports credit higher activities in domestic and export markets in the closing months of the year. Exports for the full calendar year were about 15 per cent above the 1938 total.

The price history for turpentine last year closely paralleled that for other solvents. Relatively low quotations were in effect over the first three quarters with a rising price trend in the last quarter. Holders of stocks were offering sparingly at the end of December and improved demand together with a stronger statistical position brought the market into the new year with a very favorable outlook especially as the conservation program has been extended.

Production of rosin also was influenced by the inducement held out by the conservation program. In the first half of the 1939–40 year, the total rosin produced was reported at 1,348,183 bbl. as against 1,635,207 bbl. in the like period of the preceding year. The production was divided, 900,442 bbl. to gum rosin with 17,331 bbl. additional from reclaimed gum, and 430,410 bbl. to the wood branch. For the corresponding six months in 1938 the division was 1,242,901 bbl. from gum plus 21,142 bbl. from reclaimed gum and 471,164 bbl. from wood.

Domestic consumption in the April-September period was 1,244,162 bbl.

Reported Consumption of Turpentine and Rosin

(Combined Gum and Wood Products)

	Turpentine			Rosin		
	1939–40 April–Sept. 6 mo.	1938–39 April–Sept. 6 mo.	1938–39 April–March 12 mo.	1939–40 April–Sept. 6 mo.	1938–39 April–Sept. 6 mo.	1938–39 April–March 12 mo.
	(Bbl.–50 gal.)			(Bbl.–500 lb. gross)		
Abattoirs	0	0	0	657	797	2,173
Adhesives and plastics	296	255	526	7,848	6,349	11,816
Asphaltic products	1	0	1	576	595	968
Automobiles and wagons	203	205	354	257	152	328
Chemicals and pharmaceuticals [1]	9,971	7,064	22,249	76,748	44,166	123,339
Ester gum and synthetic resins	0	0	9	68,683	43,365	108,611
Foundries and foundry supplies	322	296	576	4,603	3,169	7,950
Furniture	273	263	521	16	4	18
Insecticides and disinfectants	225	256	452	2,409	2,589	3,963
Linoleum and floor covering	69	32	68	14,803	11,931	27,313
Matches	0	0	0	1,352	888	2,240
Oils and greases	15	24	37	13,787	9,836	23,767
Paint, varnish and lacquer	29,682	27,450	51,292	74,243	62,081	130,278
Paper and paper size	0	0	0	172,108	151,438	318,361
Printing ink	251	204	489	5,603	6,092	11,564
Railroads and shipyards	2,343	1,416	3,872	495	375	1,365
Rubber	75	54	125	2,345	1,356	3,919
Shoe polish and shoe materials	4,888	2,845	10,711	5,279	4,752	10,677
Soap	5	100	213	110,275	126,034	234,927
Other industries	687	861	1,800	2,091	2,516	4,415
Total industrial reported	49,306	41,325	93,295	564,158	478,485	1,027,992
Not accounted for [2]	206,989	183,392	326,719	212,250	135,017	140,735
Apparent U. S. consumption	256,295	224,717	420,014	776,408	613,502	1,168,727

[1] Includes turpentine and rosin consumed in producers' plants in the production of unclassified derived products.

[2] Principally unreported distribution of turpentine through retailers who sell in small quantities to ultimate consumers, and unreported industrial consumption of rosin; also rosin distributed through retailers who sell in small quantities to ultimate consumers.

Production of Rosin and Turpentine

	1939–40 April–Sept. 6 mo.	1938–39 April–Sept. 6 mo.	1938–39 April–March 12 mo.	1939–40 April–Sept. 6 mo.	1938–39 April–Sept. 6 mo.	1938–39 April–March 12 mo.
	(Bbl.–50 gal.)			(Bbl.–500 lb. gross)		
Gum	270,167	386,018	534,291	900,442	1,242,901	1,792,951
Reclaimed (Gum)	0	0	0	17,331	21,142	39,979
Steam. Dist. Wood	66,234	57,045	129,091	420,031	364,592	762,913
Sulphate Wood	15,300	17,823	40,467 [1]	10,379	6,572	16,548
Dest. Dist. Wood	3,001	2,484	5,369	0	0	0
Total	354,702	463,370	709,218	1,348,183	1,635,207	2,612,391

as against 1,053,285 bbl. in the 1938 period and stocks on Sept. 30 were given as 1,728,166 bbl. compared with 1,581,530 bbl. in the preceding year. Total production for 1939–40 promises to fall considerably below the 2,612,391 bbl. produced in 1938–39 and stocks on April 1 should show a decline.

Prices for rosins were on an upward curve in the final months of the year and with receipts at distributing markets running to small volume there not only was an absence of sales pressure but a tendency to hold stocks for higher prices.

Late in the year it was announced that the program of the Commodity Credit Corporation has been approved. This program establishes basic loan values of 23¢ a gal. on turpentine in bulk and $5.15 per 280-lb. bbl. for grade H rosin with differentials for other grades. Loans are made available to producers who have subscribed to the plan for holding down outputs.

Reports from France, the second largest producer of naval stores estimate the yield of the 1939 French naval stores crop was 15 to 20 per cent under that of 1938, owing largely to the withdrawal of experienced workers during the last week of August and the months of September and October. In some areas the final dips of the season, as well as the scrape crop, were not collected. It is reported that exports of rosin are permitted only to the United Kingdom and the British and French colonies, while turpentine exportation is completely prohibited. The domestic demand for turpentine late in the year was almost entirely limited to the requirements of firms working directly or indirectly on national defense contracts. At present the French naval stores industry is under the direct control of the government.

FOREIGN TRADE

SUMMARY: *Import and export trade is passing through a stage of readjustment made necessary by international complications which arise when leading industrial nations are at war. Interference with normal movements of raw materials and finished goods, exclusion of American ships from waters within the war zone, abnormal export demand and re-allocation of suppliers to foreign markets still open to shipping are problems not yet fully solved.*

EXPORTS of chemicals and related products for the first eight months of last year were valued at about 12 per cent higher than those for the corresponding period of 1938. For the 12 months, such exports were valued at approximately $164,700,000 as against the 1938 total of $128,900,000 or an increase of more than 35 per cent for 1939. These figures briefly epitomize the effect the war had on outside buying of domestic chemical products. Startling as was the increase in shipments abroad in the last four months of the year, they do not tell the whole story about increased call for domestic chemicals as the totals shipped would have been much larger had manufacturers been able or disposed to accept all the bids which were made by foreign interests. The surge in buying orders over the four-month period had the unusual result of bringing more than 47 per cent of the year's shipments within one-third of the year.

Exports of medicinals and pharmaceuticals increased more than 50 per cent in December to a total of $2,518,000 from the $1,565,000 recorded in December 1938. Since the outbreak of hostilities in Europe, foreign demand for American medicinal products, particularly for biologics and unbranded non-proprietaries, has continued at peak levels with practically every country and trading area in the world participating. In the last four months of 1939, from September to December, inclusive, exports of medicinal prepartions from the United States reached the high value of $9,574,000 which was a 65 per cent increase over the $6,235,000 recorded in the corresponding months of 1938.

While all classes of medicinals and biologics exported have shared in these gains, the large bulk of the increase has been due to heavier demand for unbranded non-proprietaries and biologics. Some gains have been recorded with branded medicinals. Since products of this character must comply with certain registration and other formalities before they can be introduced into most foreign markets, gains in exports of this type of products will necessarily be delayed.

Two-thirds of the medicinals exported in December consisted of non-proprietaries of unbranded products and biologics. Shipments of proprietaries during the month were valued at $1,125,700 against $503,000 in the corresponding month of 1938 and exports of biologics during these periods increased in value from $211,600 to $322,400. Exports of proprietaries or branded products during these periods increased moderately from $800,500 to $853,000.

Other items on the list recording increases in December, compared with the corresponding month of 1938 included medicinal castor oil, exports of which increased in value from $8,690 to $39,600 and white mineral oil, from $40,775 to $85,325. Exports of vitamins are now assuming importance with shipments in December reaching $92,000.

Coal-tar chemicals had been moving into export channels in the Jan.-Aug. period at a rate about one-third higher than in the preceding year. In September and following months foreign buyers became active and outward shipments in the four months from September to December inclusive were equal to more than three-quarters of the total for the first eight months. Buying interest in coal-tars was extended to most of the selections including colors, dyes, stains and intermediates. Comparing the 12 months of 1939 with 1938 finds exports with valuations of $14,613,000 and $9,890,000 respectively or a net gain for last year in excess of 48 per cent. Data for exports of phenol were not included in the returns for 1938 but last year considerably more than two million pounds were sent abroad.

In recent years, export trade has been featured by the steady rise in the outward shipments of chemicals under the chemical specialties grouping. This classification takes in agricultural chemicals, insecticides, fungicides, household chemicals, synthetic gums and resins, pyroxylin products, cellulose and nitrocellulose plastic materials, and polishes. In 1937 and 1938 this group held the ranking position among chemical exports and that the trend of exports still is upward is shown by the fact under the normal conditions prevailing from

January to August, buying for foreign account had made a substantial gain over that for the similar period of 1938. These chemicals shared in the stimulus which was given to export trade as a result of war conditions but August-December gains were not as high relatively as those recorded for some of the other groups. However a net gain of close to 25 per cent for the group was registered during the twelve months.

The movement of industrial chemicals into export trade proceeded along rather routine lines through August. As a group, some improvement was shown over the preceeding year's figures but it was about in proportion to the improved industrial conditions generally aided possibly by some foreign buying intended to increase stock piles. The September-December period, however, brought a drastic change and official figures demonstrate that the value of this export business in the final four months was larger than that reported for the first eight months of the year. The volume of export inquries may be inferred from the fact that many producers of chemicals reserved supplies for the domestic trade and accepted orders for export only from sources with whom they were accustomed to deal or at the most shipped out only surplus holdings on new accounts. Highlighting the outward movement of industrial chemicals was the sharp rise in the tonnage of sodium salts shipped. The increase was pretty generally divided among the various selections. Caustic soda held the ranking place with foreign markets taking more than 130,000 tons. Soda ash, borates, and phosphates also were prominent in this movement. Total shipments of sodium salts approximate 700,000,000 lb. as compared with 519,986,000 lb. in the preceding year.

Among other industrial chemicals which attracted wide interest were calcium chloride, aluminum sulphate, acetone, butyl alcohol and acetate, calcium carbide, carbon bisulphide, and formaldehyde.

In the paints and pigments group, gains in trade with foreign countries was less spectacular than that reported for some of the other chemical groups. Some of the countries which found their usual sources of supply shut off were in the market in a more active way in the latter part of the year and from a value standpoint the year saw an increase of more than 20 per cent in foreign business. Carbon gas black is the leader in this group and despite reports that some countries abroad had been developing home production which would cut down import requirements, the results do not show that this is the case for last year saw a very marked rise in carbon black exports. Evidently the relatively low prices quoted for lithopone had an influence of foreign buyer for this pigment came in for marked attention in the latter months of the year and scored a sharp increase as a result of the year's trading.

A far-off view of export trade with South America must take into consideration the extent to which home production may be expanded in those countries. For instance Chile is credited with imports of chemicals valued at $7,750,000 in 1938. The United States supplied about 20 per cent of these imports. Recent reports from Chile state that while it is generally conceded that the country will continue, for some time to come, to be dependent upon foreign countries for fine and special chemicals, efforts are now being made to stimulate production of a number of chemical lines.

While the widespread increase in demand for chemicals which set in last September disturbed the equilibrium of the market in general, the disruption of trade with some of the nations at war, Germany in particular, aroused fears that some basic raw materials and finished products would be in limited supply and while they might be few in number, would have a far-reaching effect extending through some branches of our producing and consuming industries. With recollections of the first World War in mind, first consideration was given to potash supplies. Although a domestic potash industry had been established in the intervening years, arrivals of these products still were prominent in our import statistics. Prompt assurance was given to the fertilizer trade that ample supplies would be available for their needs. Nevertheless, the loss of imports became a decided market factor and this was particularly true for sulphate of potash which is a very valuable material for growers of tobacco. Later on announcement was made that domestic production of this material would get under way.

Chemical manufacturers who make use of muriate of potash as a basic raw material were in a divided position. Those who had contracts with domestic producers received deliveries uninterruptedly but those who had commitments with German suppliers were not so fortunate and this in turn created stronger markets for some of the salts manufactured from muriate.

Export and Import Trade in Chemicals, by Groups — 1929–1939

	Coal-Tar Products	Medicinal and Pharmaceutical Preparations	Industrial Chemical Specialities	Industrial Chemicals	Pigments, Paints and Varnishes	Fertilizers and Fertilizer Materials	Explosives, Fuses, etc.	Soap and Toilet Preparations
EXPORTS								
1929	$18,058,528	$21,282,411	$14,456,556	$28,193,913	$29,118,797	$20,444,015	$4,548,766	$16,058,680
1930	17,556,312	17,800,996	15,589,257	23,015,044	21,689,217	15,284,315	2,950,354	13,969,863
1931	10,346,921	15,103,936	13,753,889	19,774,027	15,126,846	13,011,323	1,733,714	11,282,502
1932	8,752,230	10,026,617	9,949,337	14,954,099	10,365,626	8,652,526	1,281,935	6,421,623
1933	12,422,862	9,816,253	10,663,313	16,801,699	11,834,181	8,268,968	1,526,643	5,435,716
1934	13,264,095	10,973,153	11,612,200	21,683,406	14,214,277	12,543,126	2,149,239	6,179,686
1935	13,958,701	12,239,340	12,868,471	23,627,298	16,344,957	14,809,035	2,439,418	7,207,696
1936	13,775,694	14,393,487	20,455,595	22,045,897	17,788,013	17,750,489	2,617,814	8,075,348
1937	14,877,555	17,979,326	27,526,006	27,504,817	21,543,854	16,954,367	3,863,031	9,198,245
1938	9,890,448	17,079,099	28,952,884	25,172,951	18,654,592	16,531,184	3,666,072	8,962,657
1939 (11 mo.)	12,810,555	19,799,301	31,835,179	31,467,397	20,621,873	15,791,222	3,567,700	9,262,405
IMPORTS								
1929	$22,823,597	$6,422,034	.....	$30,644,429	$3,821,148	$72,339,774	$959,501	$6,940,773
1930	16,273,163	4,947,534	.....	23,299,981	2,612,557	59,150,894	910,503	4,719,396
1931	11,162,846	3,973,072	.....	17,198,840	2,016,872	44,732,851	520,107	3,027,694
1932	9,157,885	2,530,072	.....	14,440,741	1,446,088	17,858,152	338,335	2,005,214
1933	9,997,089	3,605,089	.....	17,236,526	2,033,363	24,573,695	244,055	2,184,346
1934	11,847,058	4,234,072	.....	17,469,938	1,694,648	26,029,247	588,814	3,203,835
1935	13,557,765	4,127,588	.....	16,145,085	2,109,099	28,560,775	827,403	3,387,857
1936	15,212,009	4,890,232	.....	20,960,007	1,970,572	33,393,827	737,824	2,810,989
1937	18,353,081	4,893,994	.....	26,447,023	2,178,750	46,704,029	863,728	3,130,703
1938	15,970,206	4,328,207	.....	16,794,391	1,368,290	36,496,039	654,818	2,408,977
1939 (11 mo.)	17,634,242	4,946,900	.....	16,076,017	1,364,075	29,696,056	394,858	2,604,198

Steps have been taken to increase domestic plant capacities for muriate which is expected to bring this country to a point of self sufficiency.

Some of the potash salts including chlorate, caustic, and carbonate quickly responded to the change in import conditions and the situation in chlorate became so acute that consumers met with government officials to discuss the question of supplies. Relief was found in the establishment of a domestic output which, while controlled by one of the large consumers, agreed to distribute its output among consumers in general.

A few coal-tar intermediates of distinctly foreign origin likewise were difficult to locate and some of the consumers promptly installed equipment and began producing their own supply in order that there might be no long delay in their deliveries of finished products.

Reference to these developments brings into relief what probably has been the most important effect of the war on domestic industry, namely the establishment of domestic output for products not previously made in this country and the expansion, or plans for expanding, production of those chemicals for which partial dependence has been placed on foreign markets.

Imports of chemicals in April attracted attention because of the sharp rise in the volume and values involved. Many importers and representatives of foreign producers, with the knowledge that higher duties would go into effect in May on importations from Germany, had arranged to increase shipments from that country so as to permit of entry prior to the assessment of the increased tariffs. Total chemical imports in April were valued at $12,019,155 which represented more than 38 per cent of the total imports for the year to date. The rise in imports had very little, if any, bearing on the state of domestic industry and a good part of arrivals went to stock piles. It is also probable that a part of the month's imports represented goods which had reached this country in earlier months and had been entered in bond pending orders for delivery.

Among the receipts it was found that increased tonnages predominated in the case of chemicals which were of German origin. These included coal-tar acids, intermediates, dyes, and other coal-tar finished products, sal ammoniac, ammonium nitrate, barium compounds, magnesium compounds, and chlorate and carbonate of potash.

A review of import statistics for last year finds total receipts of chemicals to have been in excess of those brought in during 1938. The comparison for the last four months of the year is less favorable as such imports were larger in the 1938 period. For the first eight months of 1939 the values of imports were given at $54,198,000 with $48,896,000 as the 1938 figure. For the twelve months the 1939 total was approximately $79,500,000 and for 1938 it was $78,000,000, therefore imports in the last four months were valued at $25,400,000 and $29,200,000 respectively.

REPRINTS AVAILABLE

This "Report on Chemical Raw Materials" is the second in the CHEM. & MET. *series of reports to chemical engineers and executives in the process industries. Reprints of all will be available at nominal charge. Single copies of the present 32-page report plus the 6-page wall chart on chemical consumption and prices may be obtained for 75 cents; larger quantities by special arrangement. Address Editorial Department,* CHEM. & MET., *330 W. 42nd St., New York City.*

It is true that imports of many chemicals gained in volume in the latter part of last year but there were some divisions in which large decreases were recorded and as these referred to materials which ordinarily run to large tonnage, the net effect was to lower the general total. Potash salts may be mentioned as prominent among the selections which lost ground in import trade. This was logical in view of the fact that Germany was the main source of such shipments and German commerce was most adversely affected by war developments.

That the heavy export buying in September and October was not a temporary movement to replenish stocks, but rather the beginning of a trend is shown by the fact that exports continued at peak levels in December with new records being established for a number of products. Exports of such products during the last four months of 1939, the period following the outbreak of hostilities in Europe, reached the high total of $87,000,000 an increase of 85 per cent over the $47,000,000 chemicals exports to foreign countries in the last four months of 1938.

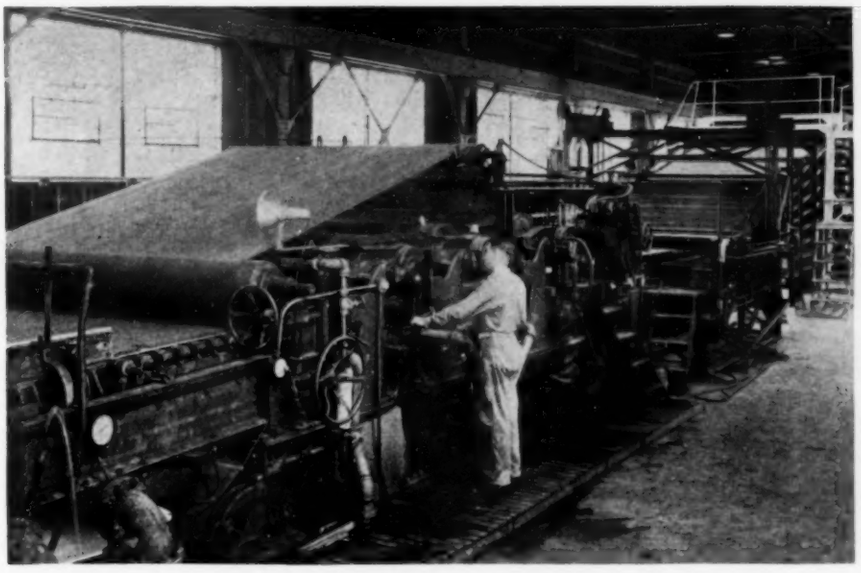
Shipments of chemicals and related products to foreign countries during December were valued at $23,102,500 compared with $13,525,500 in the corresponding month of 1938, and was the highest total reached since October 1939. Every major item on the December chemical export list, with the exception of fertilizers, recorded substantial increases, some running as high as 200 per cent above shipments made in the corresponding month of 1938. The most outstanding gain was established with industrial chemicals, exports of which were valued at $5,047,000 against $2,064,600 in the corresponding month of 1938.

Exports of chemical specialties also recorded outstanding gains, increasing in value from $2,245,700 in December 1938 to $4,205,600 in December 1939. Foreign demand for American medicinal products, particularly non-proprietary or unbranded products, continued very active with exports valued at $2,518,000 against $1,565,000 in December 1938.

Exports of coal-tar products were valued at $1,802,000 in December, compared with $1,032,000 during the corresponding month of 1938. The advance in this group was due to the exceptionally heavy demand for coal-tar dyes, colors and stains. Exports of such products in December were recorded at 2,598,000 lb. valued at $1,160,000 compared with 724,340 lb. valued at $344,400 in December 1938.

Other items and classes on the chemical and related products export list which recorded increases in December 1939 compared with December 1938, included naval stores, shipments of which increased in value from $940,800 to $1,539,500; crude drugs, from $182,000 to $291,750; sulphur, from $655,750 to $1,252,600; essential oils, from $184,800 to $394,500; paint products, from $1,775,000 to $2,139,500; industrial explosives, from $494,000 to $1,431,000; soaps, from $226,000 to $392,700; and toilet preparations, from $569,500 to $616,500.

The decreased trade recorded with fertilizers was due mainly to smaller shipments of phosphate rock. Total exports of all types of fertilizers were recorded at 70,905 tons valued at $1,349,700 which compared with 133,295 tons valued at $1,502,500 during the corresponding month of 1938. In this group, exports of phosphate rock decreased from 101,186 to 43,474 tons, but shipments of potash increased from 3,945 to 5,103 tons.



Wet end of lignin plastics machine. Process of making Benalite depends on utilizing the bonding power of lignins in the wood

New Products From Wood

Masonite has developed a method for recovery for furfural, acetic and formic acids. Carbon of the highest degree of hardness and density is produced in various shapes and sizes. Molded plastic containers are to be made. A screw press eliminates washing of fibrous material.

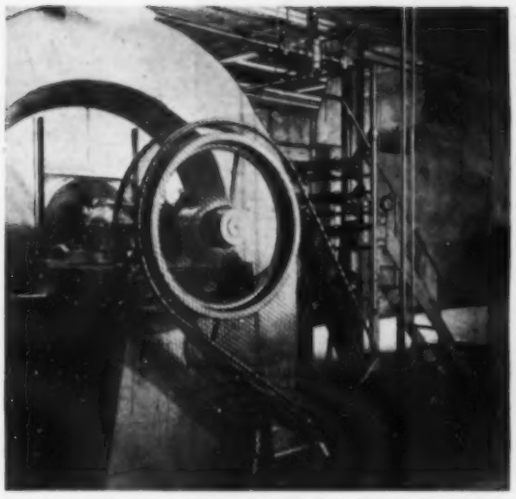
JAMES A. LEE
Managing Editor
Chemical and Metallurgical Engineering

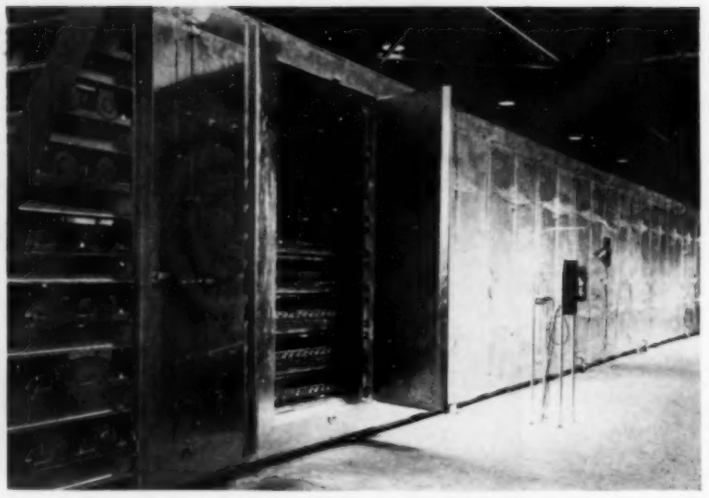
In 1925, a company was organized to produce fiber board by a process developed by William H. Mason, and a plant was constructed at Laurel, Miss. This mill has been enlarged several times and others have been built in Sweden, Italy, Australia and Canada to meet the continually increasing demand for the board products made from fiber produced by Mason's unique method of exploding wood.

The record of this young organization is a brilliant succession of developments of commercial importance. The original product is used mostly for insulating against heat and cold, sound proofing, and acoustical correction. This was quickly followed by Presdwood, a hard board of high density and marked structural and architectural values. Tempered Presdwood is a water-resistant board of remarkable strength, hardness and rich texture. Then came Quartrboard, flooring, Temprtile, concrete form board, dyed boards, DeLuxe Quartrboard, termite and fungus-proof board, Dubblseal Sheathing Board, skin surfaced insulation board—painted and unpainted. Benalite, a lignin plastic product, is attracting considerable attention at the present time. The latest and a very promising development is carbon of the highest degree of hardness and density yet obtained from wood-like materials. This carbon is unique in that it may be produced in various shapes and sizes. And now comes the news that molded plastic containers will be added to the growing list of Masonite products. And of even more importance to the chemical industries are the chemicals that Masonite plans to recover on a commercial scale from the materials which are now washed out of the wood before it is pressed into boards.

The Masonite process is based on a method of exploding wood into fibers and of welding these fibers into a dense substance with the assistance of the natural binder, lignin. The process was described in an article entitled "Converting Sawmill Waste into Profits," by S. D. Kirkpatrick, in *Chem. & Met.*, Vol. 34, p. 343, 1927.

The products with varying characteristics have been obtained for the most part by varying the degree of thermo-hydrolytic treatment — treatment with high pressure and temperature in the presence of moisture —of the ligno-cellulose raw materials. Wood chips treated under 1,000 lb. steam pressure for intervals of one or ten seconds and then exploded at atmospheric pressure result in different and distinctive types of exploded materials. The one-second material is a hair-like fiber while the ten-second material is a mixture of finely divided fiber and amorphous material. These are only two of a





Wood used in making lignin plastics is subjected to the explosion treatment. The fibrous material is then formed into sheets and the moisture reduced to 5 per cent

considerable variety of exploded materials with which Masonite is concerned.

Ligno-cellulose generally consists of varying proportions of hemi-cellulose, cellulose and lignin. The thermo-hydrolytic treatment disperses the hemi-cellulose, makes it soluble or puts it into suspension in water. It is essential to the final product that this material be removed. The cellulose is altered or partially removed depending upon the extent of the heat treatment. The longer the treatment, the more the cellulose is hydrolyzed. The volume of the lignin remains reasonably constant over a broad range of treatment but unquestionably its chemical and physical properties are altered. It is this change that makes the group of products possible.

It naturally follows that raw materials, both solid and liquid, obtained over this range of thermo-hydrolytic treatment are different and are possessed of widely different properties.

For the manufacture of one group of products, the chips (ligno-cellulose) are charged into the gun, a cylindrical steel vessel equipped with a loading port at the top, a quick opening hydraulically operated discharge valve at the bottom, and a steam inlet. The gun is filled with chips and closed, saturated steam is allowed to enter until a pressure of 600 lb. per sq.in. is reached. This requires 30 seconds. It is then quickly increased to 1,000 lb., held at that pressure for approximately one or two seconds and then quickly discharged from the gun into a cyclone. The chips explode, owing to the high internal pressure.

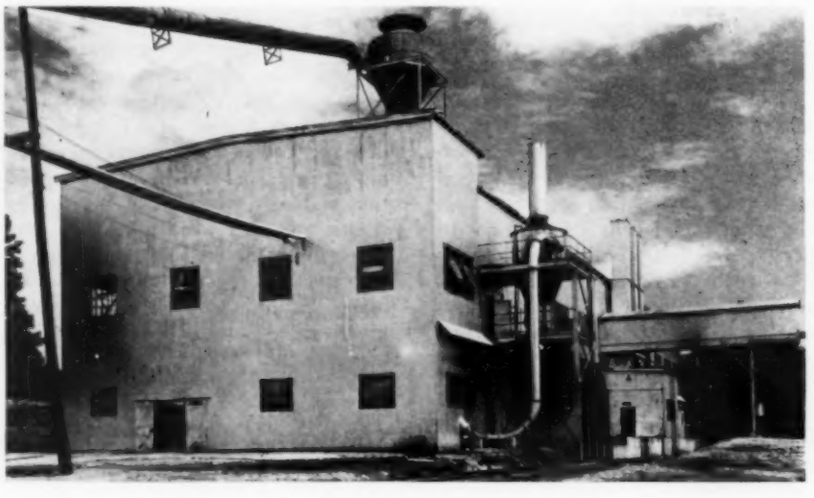
The fiber falls into a storage tank where it is mixed with water in a ratio of 3 parts of fiber to 97 parts of water. This stock is pumped through refiners, is screened, and conveyed to a stock chest. From this storage tank it passes to the board forming (a modified fourdrinier) machine. A water-proofing compound is added to the stock before it is fed onto the machine.

The blanket of interlaced fibers leaving the machine varies in thickness from three-quarters of an inch to approximately two inches. The wet blanket is carried on roller conveyors. As it moves along the conveyor its edges are trimmed, and it is cut into 12-ft. lengths. These sheets are placed in racks and conveyed, 20 at a time, to hydraulic presses. They are run into the presses by means of a moving wire screen which provides the means of escape for the steam generated in the drying presses. The length of time the board remains in the press is determined by the density and thickness of the product desired.

This represents the stock from which substantially all boards are made. In making insulation and Quartrboard the stock is not refined as much at it is when DeLuxe Quartrboard and Presdwood are the desired products. The first two are made on one machine and the latter two on another.

One type of insulation board which is now produced in large quantities has the surface fibers welded together to present a continuous, smooth skin

Lignin plastics plant of the Masonite Corp. at Laurel, Miss. Benalite may be turned, tapped and sawed



surface, but without diminishing the low density characteristics of the remainder of the boards, and without detracting from its thermal insulating qualities. The calendered surface of the board prevents dust from collecting and simplifies decoration with lacquers or other finishes.

Much of the skin insulation is coated with a protein type of water paint. About 1,500 gal. of paint are used for this purpose each day in this Masonite mill. The board may also be especially treated to make it termite proof.

Another group of products is made largely from hard wood by the process just described. The preheating treatment is similar but a longer exposure to high steam pressure is used before releasing the wood from the gun. The time varies depending upon the wood, the size of the chips and the moisture content.

This treatment gives a semi-plastic material that is converted into a hard building material in flat bed presses under the influence of heat and pressure. Elimination of the conveying wire into the presses results in a board with both sides smooth.

A third group of products is made from either hard or soft woods. The wood is subjected to the same preheating treatment but is held in the reactor at high steam pressure for a considerably longer period under controlled pH conditions. This material is used for the basis of the lignin plastics. It is formed into sheets and the moisture reduced to 5 per cent. The sheets are put in a flat bed press and subjected to a pressure of from 1,500 to 2,000 lb. per sq.in. at sufficient temperature to cause conversion to the cured state. Benalite so made has a specific gravity of 1.44. It may be turned, tapped, and sawed.

The semi-commercial chemical plant. A source of chemicals is found in waste material obtained in production of Masonite board products

One of the more recent research developments, which is now in the pilot plant stage, is the investigation of a new mode of making activated carbon from wood. The wood, either hard or soft, intended for conversion into carbon products is given a different degree of thermo-hydrolytic treatment than used for other products. Its carbonization conducted at a temperature of 400-450 deg. C. for approximately 6 hours will produce a primary carbon having a high specific gravity. This primary carbon is then activated in accordance with the usual procedure. That is, it is subjected to 800-1,000 deg. C. for a period of from 2 to 4 hours in the presence of flue gas and steam.

A source of the chemicals is found in the waste material obtained in the production of Masonite board products. When the wood is exploded, a portion of the hemi-cellulose is broken down to hexosans and pentosans and other products due to the steam pressure and to the organic acids formed during the heat treatment and explosion. These and part of the lignin are water soluble and it is necessary to free them from the fibrous material before making the board.

At present these constituents are removed by washing but the enormous volume of 3,000 gal. of water per minute is required. An even more important feature is the fact that the wash water has only a concentration of 0.6 per cent dissolved solids which is not an economical source of wood sugars.

Recently, a new method for the removal of the hemi-cellulose was developed with a screw press substituted for the washing procedure. It is similar to the operation used for squeezing sugar out of cane. The press expels a large portion of the water solubles from the wood fibers without damaging them. This development is also in the pilot plant stage, but upon the installation of the proposed chemical byproduct plant and commercial use of this pressing treatment, enormous savings can be made in the consumption of water and a concentrated wood liquor secured as the raw ma-

Exterior of the semi-commercial plant for the recovery of furfural, acetic and and formic acids and other chemicals

terial for an ambitious chemical manufacturing program.

Of these solids approximately 70 per cent are sugar forming materials. The sugars obtainable are glucose, galactose, mannose (the hexoses) and xylose and arabinose (pentoses). With the present capacity of the board mill there is a potential output of 150,000 lb. of the sugars per day.

There remains about 30 per cent solids that are unaccounted for. These are partially degraded lignin and decomposition products of cellulose.

The hexose sugars may be utilized in fermentation or in the synthesis of other organic compounds. These pentose sugars may be either fermented or converted into furfural, and acetic or formic acids, and/or other organic products can be obtained. The research staff has developed a method of separating the pentose from the hexose sugars.

From the 30 per cent solids can be derived tars, fatty acids, waxes and resins.

Methods for the recovery of furfural, acetic and formic acids have been developed. This work is in the semi-commercial plant stage and plans are now being considered for the erection of a large plant to house this proposed new department of the Masonite Corp.

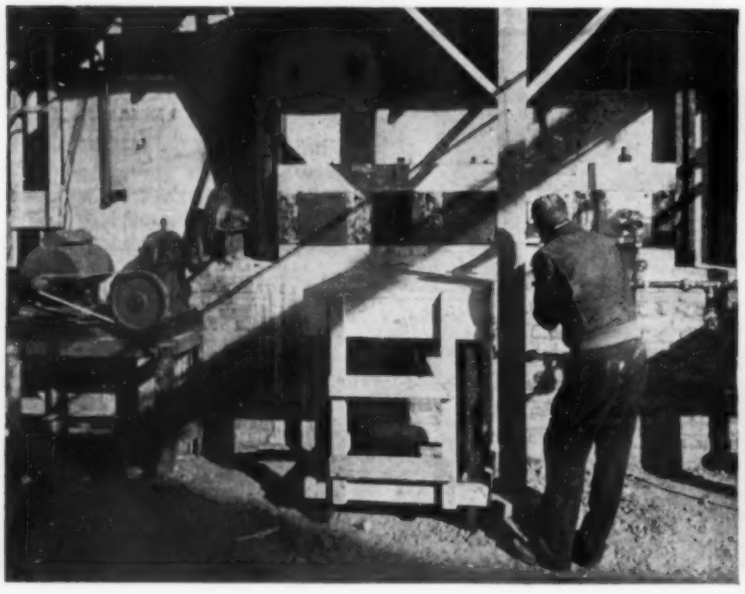
It has long been the practice to produce furfural by the treatment of pentose sugars with mineral acid at steam pressure of about 50 lb. Masonite's availability of high pressure (1,000 lb.) steam at a low cost has enabled the company to increase the speed of this reaction to the point where a few seconds of time produces as much finished product as several hours at the lower pressure. In fact, it has been found that various unexpected and most interesting developments have resulted when wood products are submitted to high steam pressure.

The steam explosion gun used by Masonite to explode wood chips and for other purposes has other uses in industry. One is in the field of rubber reclaiming. One of the large rubber companies chops up old tires and uses the Masonite gun to explode the pieces in order to separate the rubber from the fabric.

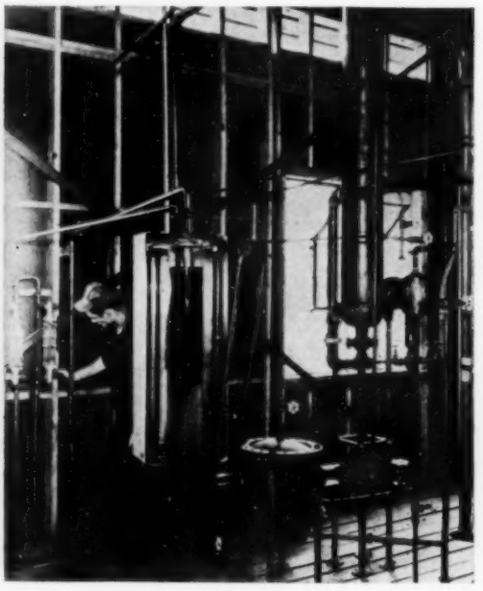
PHYSICAL PROPERTIES OF MASONITE PRODUCTS

Type of Board	Insulation	Quartrboard	De Luxe Quartrboard	Presdwood ⅛ in. Thick	Tempered Presdwood ⅛ in. Thick	Benalite
SPECIFIC GRAVITY	.32	.62	.90	1.03	1.10	1.44
MODULUS OF RUPTURE	405	2,200	3,400	6,200	11,000	17,000
MODULUS OF ELASTICITY		290,000	420,000	550,000	850,000	2,000,000
TENSILE STRENGTH LB PER SQ IN	194	1,165	2,200	3,200	5,100	10,000
ROCKWELL HARDNESS SCALE R		.37	0	48	75	
ROCKWELL HARDNESS SCALE M						109
LB PER SQ IN. REQUIRED TO COMPRESS BOARD 10%	80	815	2,820	4,825	7,325	
WATER ABSORPTION % UPTAKE 2 HR	17.2	11.0	5.6	5.5		
WATER ABSORPTION % UPTAKE 24 HR	46.3	35.0	18.9	16.0	11.7	.75
WATER ABSORPTION % UPTAKE 48 HR					15.6	1.25
HEAT TRANSMISSION COEFFICIENT	.33	.55	1.25	1.35	1.50	
DIELECTRIC STRENGTH						300-400V PER MIL

After the thermo-hydrolytic treatment the material is carbonized at a temperature of 400–450 deg. C. for approximately 6 hr.



Within the chemical plant, showing the extractor level



Advances in Menhaden Reduction

Centrifugal processing of menhaden oil has resulted in greater yields, an improved product and the solution of a waste disposal problem. The new process eliminates the gurry emulsion, source of the odor to which both workers and public objected.

J. HOWARD SMITH
President
Fish Products Co.
Port Monmouth, N. J.

THREE-QUARTERS of a billion menhaden, aggregating over 65,000 tons annually are converted into dry scrap, acidulated scrap, meal and oil by the menhaden fishing industry. Great strides have been made in the methods by which these products are obtained, and modern equipment and methods are rapidly replacing the antiquated systems in use along the Atlantic Coast for so many years.

Until two or three years ago the process used consisted of cooking the fish in large vats, pressing the cooked fish to remove the oil and catching the press liquor in a series of settling tanks. Between the layer of oil which rose to the top and the very considerable volume of water from the press was an emulsion layer. To clarify this oil which had risen to the top and to break the emulsion, both layers were skimmed off to another tank where the oil was recooked. This second cooking caused the coagulation of the albuminoids and proteins, freeing some of the entrained oil. The "clear" oil was then decanted off, and the gurry emulsion, as the new intermediate layer was known, was drained to a gurry tank. The emulsion gradually decomposed in the gurry tank, liberating a further amount of dark-colored, low grade oil, which was in some plants skimmed off by hand dippers and in others, filtered by means of plate and frame filters. The bottom layer, consisting of sludge and water was run to waste.

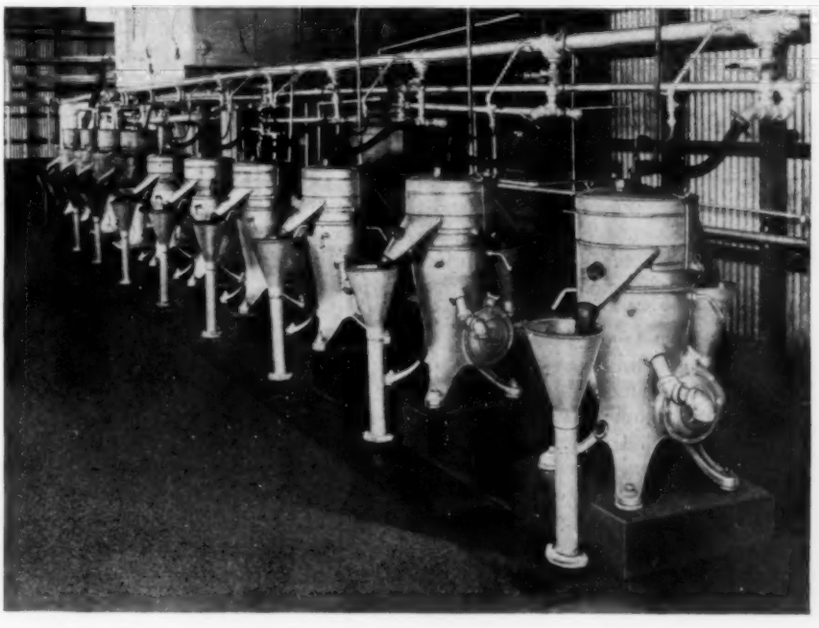
This method left much to be desired. The gurry emulsion was a foul-smelling mass, nearly impossible to live with and difficult to dispose of. Streams into which this gurry emulsion drained were instantly polluted, and with this old-fashioned settling tank system, from 3 to 5 per cent of suspended fish particles were lost in the water which was drained from the second tank. Today that percentage of suspended fish particles can be recovered effecting an important saving.

Virtually all producers had long recognized the need for a more efficient system. In spite of most careful attention to settling tank systems and the control of temperatures and water levels, the overflow water carried oil. That these losses amounted to as much as 5 per cent was not known for some time, but was finally determined by tests. Sometimes the losses far exceeded this figure, as when the fish were soft, and the water was badly emulsified.

Lately, the most modern menhaden recovery plants along the Atlantic Coast have eliminated most of these difficulties by introducing modern methods. Practically all of the waste in the water is recovered. This has been made possible by the use of continuous discharge slime separators such as those made by the De Laval Separator Co. These slime separators are rapidly replacing the settling tanks formerly used.

The first two units of the "flow chart" of today remain unchanged from the older method. The fish are

Bank of centrifugals in a menhaden reduction plant; the six shown in the foreground are slime separators, the remaining four are fish oil purifiers



carried from the ship's hold by conveyors to a "quarter-box" where the fish are counted. A revolving rotor unit within a stationary cylinder divides this cylinder into four equal partitions. When a quarter-cylindroid is filled, it is turned, and while the next succeeding compartment begins to fill from the inlet at the top, the tally (approximately 1,000 fish) is recorded as the fish spill out of an outlet on the bottom.

Next the fish are cooked in long cylindrical steam fed cookers. Fish entering at one end are conveyed by a screw arrangement and leave the other end of the cooker. From 75,000 to 135,000 menhaden can be handled per hour in each cooker. Great care is taken to see that the fish are neither overcooked nor "soft". Either would be too difficult to press.

Presses next squeeze out the oil by subjecting the fish to gradually increased pressure as a worm fitting closely within a cylindrical curb forces the fish through. The press cake goes to a hopper; the water and oil are discharged into pipes which lead to a large rotary screen. This screen removes most suspended solids.

Up to this point the 1940 menhaden recovery plant is essentially the same as that of 1937. But next, instead of being led to settling tanks, the liquor from the rotary screen is led through a vibrating screen to the continuous-discharging centrifugal De Laval slime separator. Through small nozzles inserted in pockets in the bowl shell of this machine, the fine solids still remaining in the press liquor are continually discharged with some water. Thus it is not necessary to shut down frequently for bowl cleaning—the handicap which for years had prevented the utilization of centrifugals by menhaden plants.

Liquor entering the centrifugal slime separator is at once separated into three components: Solids with some water, water containing colloidal matter which with the solids is chemically treated and then returned to the disposal plant, and the valuable oil, containing only a small amount of water. This oil is led from the top discharge spout to a centrifugal fish oil purifier where last traces of water are removed. A heating tank generally is inserted between the two centrifugals.

Thus the oil is separated from impurities and water without entering a settling tank. The gurry oil problem, an important factor in the odor and pollution difficulties formerly experienced, is entirely solved. Both the quantity and quality of the recovered oil is better than that obtained by old-fashioned methods, and because of the absence of contaminating substances, oil can remain in storage for long periods without danger of deterioration.

The operating savings are equally important. Human attention is reduced to a minimum, and because separation follows immediately upon pressing, considerable time is saved.

The fish meal is dried to remove the moisture still remaining and the dried meal is packed for poultry and animal food and fertilizer. In some cases the fish meal from the press is acidulated by means of sulphuric acid and sold as a fertilizer, usually in an unground condition. The oil, most valuable of the recovered products, is used chiefly by soap manufacturers. Some finds its way into cheaper grade paints and some is utilized in the manufacture of linoleum.

Design for Distilled Water

As a part of the careful planning in this new plant, the distilled water production and distribution system serves present needs and can easily be tapped to supply future expansion.

AUBURN A. ROSS

Department of Design
Eli Lilly & Co.
Indianapolis, Ind.

PRODUCTION of pharmaceutical products requires that strict standards of high purity be maintained entirely throughout manufacture. This applies not only to the production of medicaments in dosage form, but also to the manufacture of fine chemicals and organic medicinals. Of equal importance is the use of pure ingredients, whether they be gaseous, liquid, or solid. Of the liquids, none is more commonly used than water; hence it is essential that in many instances distilled water of the highest quality be used.

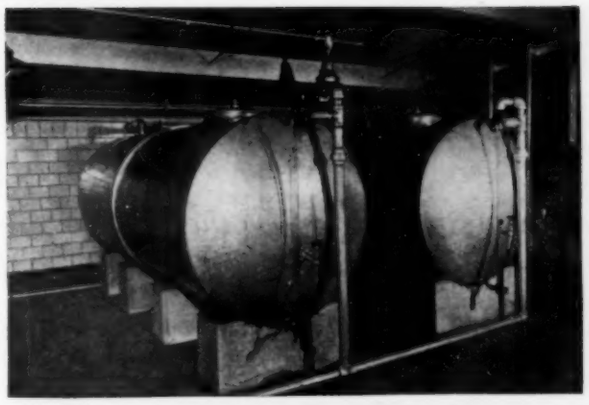
Within the last year Eli Lilly & Co. has put into operation a new unit for the large-scale production of certain organic medicinals. Included in this unit is a distilled water system which is believed to have several improvements over one recently described. (*Chem & Met.* **46,** 226, 1939.)

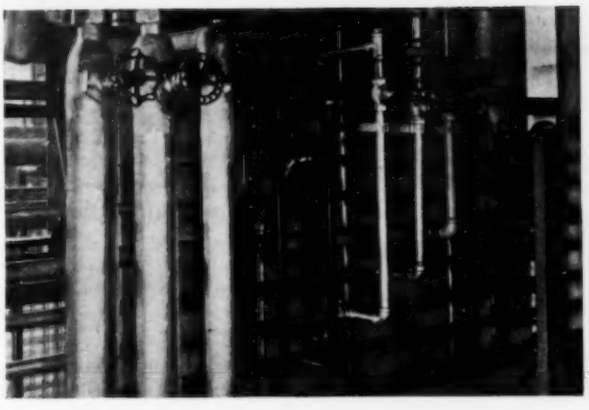
Design of the Building

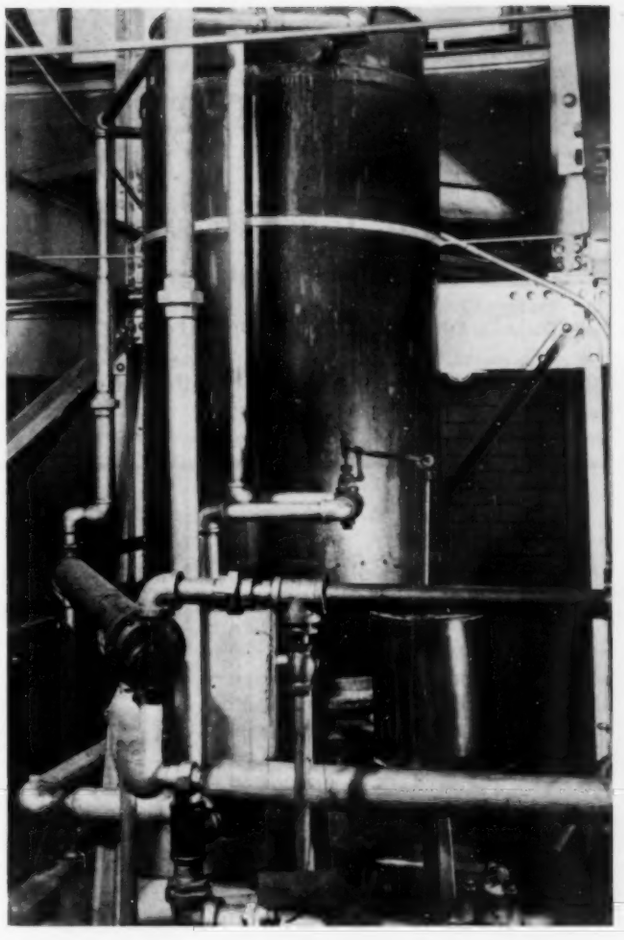
A brief description of the construction of the building is essential to a thorough understanding of the engineering details of this distilled water system. This manufacturing unit is approximately 136 ft. long, 53 ft. wide, and 48 ft. high, and is constructed of brick, reinforced with steel columns. The interior of the building has a reinforced concrete ground floor and two mezzazines of corrugated iron floor tread, supported on steel beams and columns. Ample natural lighting and ventilation are obtained by means of ordinary steel sash, factory type windows, supplemented with large panels of glass brick. The roof is constructed of pre-cast concrete slabs supported by a truss construction.

All manufacturing equipment is located in two side bays running the length of the building. This allows the center bay to be left open up to the roof truss construction, to permit easy installation and moving of the equipment to either mezzanine. Above this truss-work of the center bay and extending over the center portion of the building is a monitor, which serves as an aid to natural ventilation, as well as storage space for steam ejectors and any necessary forced exhaust systems of the building.

Since the total height of the truss, below the monitor, and the monitor itself is 16 ft., the erection of a concrete platform at the bottom level of the truss-work provides an adequate space for the installation of the distilled water still. This piece of equipment is a standard industrial still, capable of producing 100 gal. per hr., and is equipped with a special steam







Water still, storage tanks for distilled water, and utilities distribution system of new Eli Lilly plant

trap assembly so arranged that the boiler water condensed inside the main heating coils is run back into the make-up water tank as feed water. The feed water tank is also equipped with a float control so that any deficiency of water is made up with tap water. Inasmuch as this unit operates on hard water, much liming of the heating coils occurs; consequently, an extra coil assembly is provided so that the still may be operated with as few shut-downs as possible. In order that these coils may be changed with a minimum amount of mess, the still platform is supplied with an adequate drain.

All of the rooms necessary for plant operation are located in one corner of the building. There is a shower and locker room on the ground floor, office and control laboratory are on the first mezzanine, and the electrical control room is on the second mezzanine. By such an arrangement, adequate space is provided in the truss-work and immediately below the roof for the location of two distilled water tanks. These are horizontal tanks, 48 in. inside diameter and 11 ft. long and have a capacity of 1,000 gal. each. Of all welded construction, they are made from ⅛-in. 2S aluminum alloy sheet, which is 99 per cent aluminum. These tanks are further provided with: 16-in. manholes with loosely fitting covers; 2-in. openings on the top side which serve as a vent and an inlet from the still, graduated gage glasses across the front head, and 2-in. bottom outlets by which the water is discharged into the distribution system of the building.

The design of this building not only makes the present equipment conveniently operable with the minimum amount of labor, but also in the future will permit quick and easy installation of any new equipment for different processes. In order to do this, all utility lines must be exposed and easily accessible at all times. Therefore these lines are carried around the entire building as a group on a rack located on the first mezzanine near the wall. Connections, placed at suitable intervals, make it possible to convey these services to the equipment on the first mezzanine, while services for the equipment on the ground floor and second mezzanine are supplied from the same connections by means of vertical risers, descending through a one ft. air space left between the outside wall and the steel beams and columns of the mezzanine floors. Included in these service lines is a ¾-in. distilled water line which is connected to the 2-in. outlets on the storage tanks. By this method the distilled water can be piped either to open taps or directly into any piece of equipment. This pipe is made of 2S aluminum alloy and all joints in the lines are made with standard, tapered pipe thread. All fittings in these lines, such as ells, tees, etc., are of 43 aluminum alloy, which is a cast alloy containing 5 per cent silicon. Globe valves cast from this same alloy are also used throughout.

Thus, through proper engineering and design, distilled water of a quality equivalent to that of the United States Pharmacopoeia XI is delivered direct to the manufacturing equipment, making it possible to produce organic medicinals of high purity on a large-scale basis and upon the principles of straight-line production.

Granulating Phosphate Fertilizers

An article by R. S. McBride appearing in our January issue described the manufacture of sulphuric acid and superphosphate at the Curtis Bay plant of the Davison Chemical Corp. To round out the picture our present authors explain the efficient new granulating process used by the company for both superphosphate and mixed fertilizers.

J. N. MACKALL
and
MARK SHOELD

Respectively, Vice-President and Director of Research
The Davison Chemical Corp.
Baltimore, Md.

FERTILIZER is normally made up either of superphosphate or mixtures of superphosphate with other plant foods without close size control or granulation of the particles. But during the past five years much of the product of the Davison Chemical Corp., at Curtis Bay, Baltimore, has been prepared as a granulated material. The methods of manufacture of this product vary significantly from those usual in the fertilizer industry. And the product, which has been patented, has achieved considerable acceptance despite its comparatively recent availability.

The first production of granulated phosphatic fertilizer was by the Oberphos process, which was comprehensively described in *Chem. & Met.* (Apr. 1934, p. 178ff). The primary objective of this process was the manufacture of granulated phosphatic fertilizer, a result achieved by elevated temperature and pressure processing. The development was made by G. Ober & Sons Co., which organized The Oberphos Co. as a development and marketing agency. Both these enterprises are now wholly owned by Davison, which company controls both the original process patents, the product patent (U. S. Reissue No. 19,825) and the new Davison granulating process (U. S. Patent 2,136,793) which is here described. At the present time production according to the Davison process is carried out in two granulating units, one of 500 tons per day and the other of 1,000 tons per day capacity. Another plant of Davison has a third granulating unit of 500 tons per day capacity, operating at Nashville.

The accompanying flow diagram shows the difference between the granulating process when applied to superphosphate and the normal methods for manufacture and preparation of this primary fertilizer material. It will be noted that the new process is shown as starting with raw superphosphate taken direct from the den, but it can also be applied to mixtures of superphosphate and other plant foods.

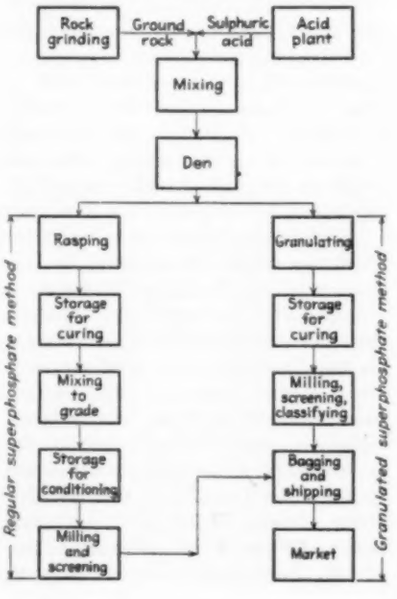
Granulating Process

To granulate either superphosphate or mixed fertilizer requires treatment in two stages which follow each other immediately. In the first stage, the material is conditioned, i.e., its moisture content is adjusted accurately to that at which the granulation best takes place. In the second stage, the material so moistened or conditioned is dried while passing through a rotary kiln unit where the globular or granular form is fixed or set by the heating and drying.

One important point of the process is to feed the material from the conditioning cylinder to the drying cylinder in exactly the right physical condition and correct moisture content. Experienced operators are required as the control is visual. The operator who exercises the control is stationed at the discharge end of the conditioner which is brightly flood-lighted where the material passes under his inspection. This operator must be continuously present and a relief operator is provided to take over immediately if the one regularly on duty must leave this station even momentarily. The control is by manual operation of the valves which feed the water to the sprays within the conditioner chamber.

The accompanying diagram shows the interrelation of equipment as applied either to superphosphate or to mixed goods. The feeding system at the upper left of the drawing is that used for superphosphate, while that at the upper right shows the type employed for mixed fertilizer. Referring to the left-hand arrangement, the crude superphosphate is brought by crane from the den to the hopper at the top of the system. Here a predetermined amount of classifier dust is mixed in. The quantity of dust added depends both on the moisture content of the superphosphate from the den

Flow diagram of regular and granulated superphosphate processes as used by the Davison Chemical Corp.



and on the available supply of dust. Normally an amount of dust equal to about 10 per cent of the dry superphosphate is used. At times the percentage is as high as 18 or 20 per cent of the mixture. A variable speed control adjusts the feed of this dry material on to the pan conveyor from the feed hopper. The mixture enters the rotary conditioning cylinder where the spray water is added. The conditioned material discharges at the lower end of the conditioner directly into the feed hopper at the hot end of the dryer.

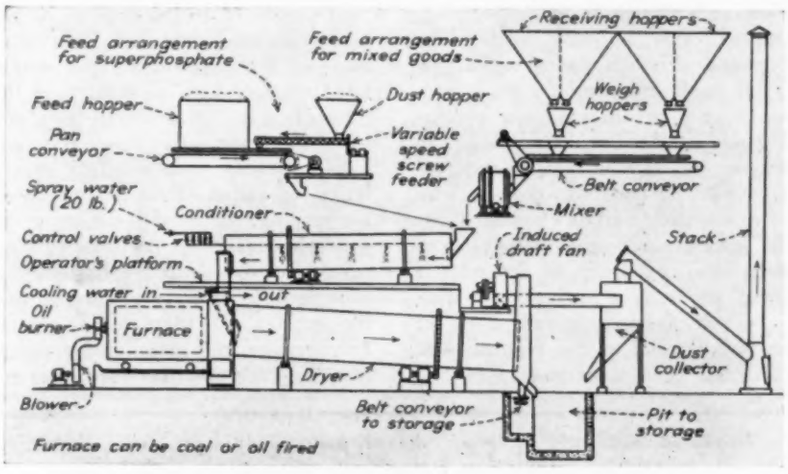
The dryer is a cylindrical unit about 8 ft. in diameter and 50 ft. long rotating on tires and rolls. The conditioned material enters at the hot or furnace end through a water-jacketed feed chute and progresses downward to be discharged at the lower or cool end either on to a belt conveyor which takes it to storage or into a pit from which it is craned into stock piles.

Either coal or fuel oil may be used for firing the furnace. Oil burners with air blast are employed at the Curtis Bay plant. When the large granulator is operating at 50 tons per hour, it requires about 100 gal. per hour of Bunker C oil for heating. The firing is through four burners of the low pressure type with air furnished by a high-speed centrifugal blower. Recording pyrometers and thermometers are used to maintain optimum and uniform operating conditions.

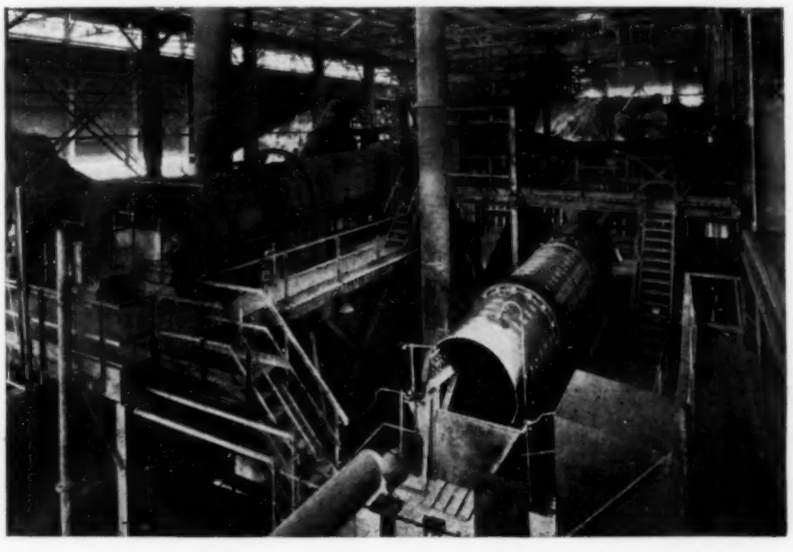
The products of combustion pass out through a breeching at the discharge end of the dryer and are forced from this point by a draft fan through a cyclone dust collector and thence through a gooseneck crossover out of the stack. This exit gas must be maintained at a sufficiently high temperature to prevent condensation of the moisture in the gas before it leaves the stack.

There is a considerable advantage when granulating superphosphate in taking this material warm and moist direct from the den. This not only conserves heat, but also makes dust and moisture admixture easier and the entire granulating operation more efficient. Generally the superphosphate from the den carries slightly more moisture than that desired for the feed of the granulator. For this reason alone it is desirable to add a considerable percentage of the dry classifier dust. However, practical approach to the desired moisture content can be made only by water addition and not conveniently by control of the dust addition. Typical moisture contents at the various stages are shown in the accompanying table.

Schematic equipment arrangement for Davison's granulating process, with different feeding devices shown for superphosphate and for mixed goods



At the left is the conditioner for the 1,000 ton granulating unit and at the right the 500 ton per day unit; the dryers appear below the conditioners



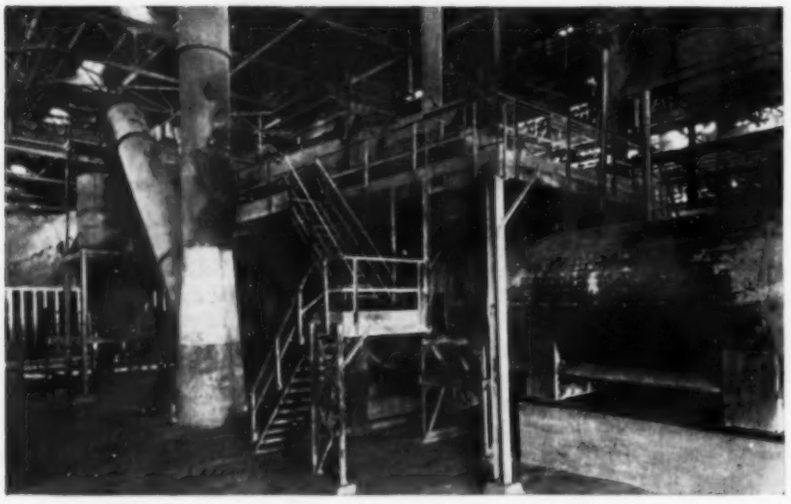
Granulating Phenomenon

Something more occurs during granulation than mere balling up of the material into small spheres. That change in the physical form is, of course, a primary objective. There is also accomplished during the processing a further completion of the acidulation, most of which occurred in the mixer and den. After granulation while the material is in storage for a minimum of ten days, this acidulation goes on still further until about 95 per cent of all of the P_2O_5 present in the superphosphate is in the available form. The final percentage of acidulation is predetermined and it may be varied to suit conditions. In this case 95 per cent acidulation makes a flat 20 per cent granulated superphosphate.

The analyses in the accompanying table represent averages of over 1,000 samples taken during manufacture and shipping of a substantial quantity of granulated superphosphate. It will be noted that the moisture elimination from den to discharge of dryer is about 5 per cent. The residual 5 per cent of water in the granulated material disappears in two ways. About 2 per cent is changed from free water to fixed moisture during the

Typical Analyses of Superphosphate

	From Den, Per Cent	From Granulator, Per Cent	Shipments, Per Cent
Moisture	10.56	5.15	1.67
Total P_2O_5...	20.03	21.08	21.44
Insoluble P_2O_5	3.04	2.75	1.18
Available P_2O_5	16.99	18.33	20.26
Extent of conversion ...	84.7	87.0	94.5



The 1,000 ton granulating unit showing the conditioner above, dryer below, and stack and dust collector at the left

curing which occurs between granulation and shipment. About 1½ per cent is true moisture loss, that is, evaporation during the handling, screening, classification, and storage.

Granulating Mixed Goods

When preparing mixed fertilizer in granular form, the process differs but slightly from that applied to raw superphosphate. As shown in the feed arrangement in the upper right-hand part of the sketch, the various materials to be put into the mixture are fed onto a mixing belt through weigh hoppers by use of a series of receiving hoppers. These materials are mixed together to secure uniformity and then discharged into the feed hopper above the conditioner unit. A variable speed feeding unit carries the material from this hopper into the conditioner where it is moistened to the desired degree by manually controlled water sprays, just as the mixture of raw superphosphate and dry dust is treated. From this point on, the product is handled substantially as in the case of superphosphate.

When granulating mixed goods, the moisture content of the material as it passes from the conditioner to the dryer is usually 16 to 18 per cent. Such material, of course, includes the classifier dust returned from previous sizing operations of the same formula. Generally for mixed goods this dust amounts to 10-12 per cent of the mixture treated, a ratio less than normal with granulated superphosphate.

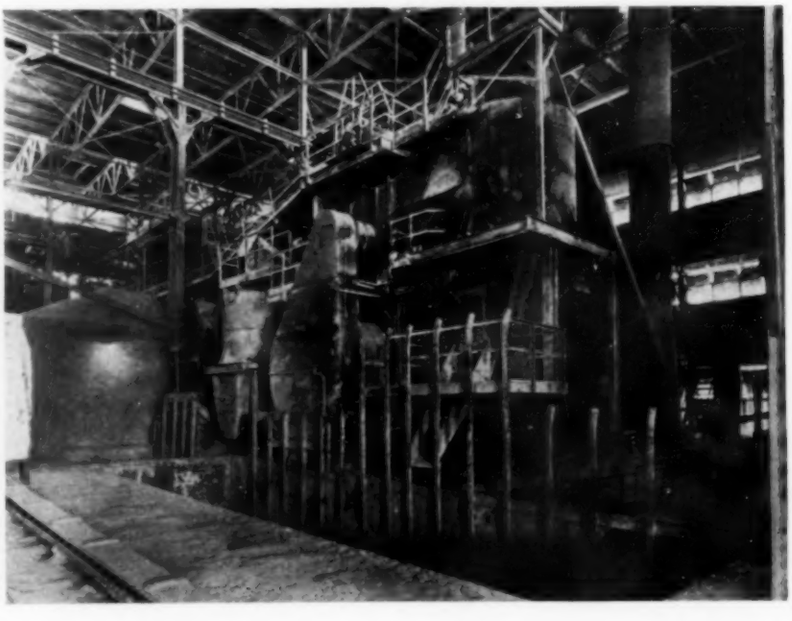
After the granulated material has been in the stock pile a suitable period, which is a minimum of ten days for granulated superphosphate, the material is picked up by an overhead crane and carried to the classifying, bagging, and shipping units. The screening of either superphosphate or mixed goods in granular form is necessary in order to maintain reasonable size uniformity of particles. The oversize is milled down and rescreened. The undersize goes back to the granulating unit as classifier dust. The same general principle applies to sizing and handling of granulated mixed goods. The quantity of dust to be regranulated depends both on the formula and on the type of rock which has been acidulated.

The sized granular material may be sold as such for direct use or may be mixed with other granulated materials in order to prepare the various formulas desired in agriculture. To secure satisfactory behavior during shipping and handling it is necessary to have a reasonably close uniformity of size of material in the granulated mixtures. This avoids the segregation which would occur if a granular material of one composition were to be bagged or shipped in bulk with material of quite different size and density characteristics. Two typical granulated base formulas made at Curtis Bay are 7-7-7 (N-P_2O_5-K_2O) and 0-13-20. A number of important and popular formulas are prepared by mixing as above described.

Economic Advantages

The cost of making granulated superphosphate is no higher, often it is cheaper, than the making of a finished "flat grade" of 16 per cent or 20 per cent pile-cured material. The extra processing in preparation of a granulated product costs no more than the rehandling and treatment of the crude superphosphate raw from the den would normally require. This granulating operation eliminates the need for rasping, the need for moving the superphosphate in the pile during cure, and substantially shortens the time between original acidulation and the earliest safe date for shipment. Furthermore, the granulated material is a flat grade and, therefore, does not

Discharge ends and receiving pits of both conditioners, with discharge breechings, exhaust fans, cyclone collectors and one stack visible



require either addition of triple-super for sweetening up the run-of-pile to make the ordinary 20 per cent den super, nor the cutting back with sand or dolomite, which a flat 16 per cent den super requires. By selecting the BPL between 72 and 73 per cent for either Florida or Tennessee rock, a 20 per cent granulated superphosphate is made direct.

There has been very general acceptance of granulated fertilizers in widely distributed parts of the country. Some of the major advantages include prevention of caking during shipment and storage, non-segregation of materials in mixtures, and ease and uniformity of distribution on the field. The latter is of course an agronomic advantage making for maximum crop yields. An additional proven agronomic advantage is the minimizing of phosphorus fixation in the soil.

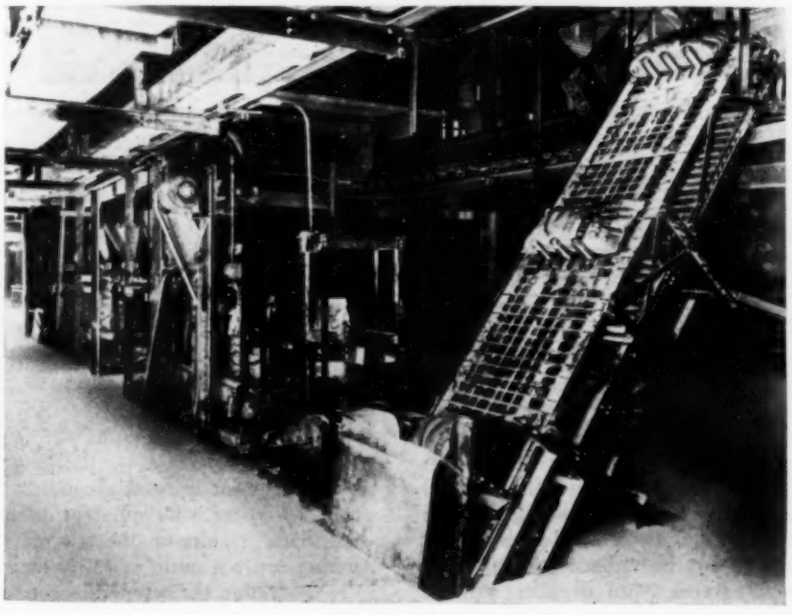
Fertilizer mixing unit in the Davison plant; such units can handle up to 12 different components for complicated mixtures

A great deal of the granulated superphosphate and granulated mixed goods is shipped direct from the primary manufacturing unit either in bulk or in paper bags. The Curtis Bay plant has been a pioneer in the use of paper bags which have found wide acceptance in this field.

One of the important manufacturing units at the Curtis Bay plant is a mixed fertilizer building, one formerly owned by another company now absorbed by Davison. In this part of the plant are the conventional type of mixing, bagging, and shipping facilities. Some of the mixing equipment is capable of handling up to 12 separate components to prepare the most elaborate mixed-fertilizer formulas. Most of the shipments are, of course, less complex than this.

A great variety of formulas is required for shipment from this plant because a substantial quantity of the material manufactured goes by rail or water for redistribution at other relatively distant points where formulas differ from those used locally. Baltimore is a logical center for such distribution, including the shipment of a great deal of superphosphate which goes to other plants of the Davison organization where final mixing is done for local distribution. Many of the water-borne shipments are thus destined for further processing and sale in Virginia, the Carolinas, Georgia, and other big fertilizer-using states on the Atlantic Seaboard and Gulf Coast.

Ultra-modern automatic bagging equipment, used for the handling of granulated fertilizers when they are packed in 100-lb. paper sacks



Mechanical Bagging

In the main superphosphate building there are both the conventional facilities for fertilizer handling as well as ultra-modern equipment for sizing and packaging, the first of its kind in a superphosphate plant.

A new large-scale mechanical bagging unit that will fill paper bags with either mixed fertilizer or granulated superphosphate has proven very advantageous. The purpose of this unit is just the same as the large-scale manufacturing units, that is, quantity handling at lower unit cost for labor and lower capital investment per ton of product shipped.

This plant has gone much farther than any other in mechanical bagging and in the use of paper bags. Usually the paper containers are for 100 lb. of superphosphate or mixed goods. Burlap bags of a larger size reduce the number of units handled per ton of goods, but are more expensive than paper per bag. The net cost of the bagging is about the same per ton for either kind of bag. There is, however, a growing demand for the paper bags because they are neat and attractive and the 100-lb. unit is most convenient to handle, both in shipping and on the farm. This trend is strongly encouraged by the Davison organization which believes that such a standard package will result in the most economic over-all marketing plan.

Paint Baking With Near Infra-Red

Since incandescent lamps radiate about 90 per cent of their input energy, they are efficient sources of heat which may be used for drying lacquers and enamels. In this article are discussed advantages and applicability of this method of paint baking.

H. J. BENNETT
and
HOWARD HAYNES

Respectively of Glidden Co., Cleveland, Ohio, and Nela Park Engineering Department, General Electric Co., Cleveland, Ohio.

Bank of 144 tungsten filament lamps in gold plated reflectors drying file cabinet parts. Drying time for baking enamel used is five minutes

DIRECT APPLICATION of radiant heat from incandescent lamps to drying and baking of paint films in many cases offers several advantages over conventional methods. These advantages of greater speed, lower equipment and installation costs, cleaner and more comfortable working conditions, greater adaptability to changing schedules, and elimination of warm-up periods are responsible for the present interest in this method.

Any hot substance emits infra-red radiation. The hotter the substance, the shorter will be the peak wavelength of the radiation. Ordinary ovens at 250 to 350 deg. F. emit radiant energy of a fairly long wavelength, peaking at about 50,000 angstrom units, but only a small portion of the energy in such an oven is in radiant form. The new type of baking oven under discussion provides infra-red radiation with the major portion of the energy involved below a wavelength of 20,000 angstrom units. To provide this wavelength radiation with an incandescent body, the body must have a temperature of 1,500 deg. K. or higher. One might say that the sun, with a temperature of 6,000 deg. K. is the best known source of energy of the shorter wavelengths. The filaments of ordinary Mazda lamps have temperatures ranging from 2,600 to 3,200 deg. K. Carbon lamps operate at a lower temperature (of the order of 2,000 deg. K). Calrod resistance heater units are now being manufactured to operate between 1,200 and 1,500 deg. K. However, the calrod units, not being enclosed in a bulb, are cooled by the surrounding air and for this reason are less efficient producers of radiant energy. The higher color temperatures and efficiencies obtained with incandescent lamps point to their general use for most infra-red baking ovens.

It was originally supposed that the greatly reduced baking time obtained with infra-red lamps was due to some marked catalytic or accelerating effect exerted by the radiation itself. However, several types of tests indicate that the temperature attained by the work is the controlling factor and that the phenomenal results obtained are really due to the higher temperatures reached in a short time. The simplest and most decisive of such tests consists of painting both sides of a metal panel and subjecting one side only to the radiation. If the panel is relatively thin (i.e. 22 gage) so that the heat is readily conducted through it, there is no apparent difference in the results on the two sides. Another test not quite so easily made is to determine the temperature time

curve for a given specimen under drying lamps and then arrange oven conditions so that the same temperature time curve is duplicated in the oven. When this is done, baking times under the two conditions are found to be the same. Therefore, it is concluded that there is no magic in radiant energy baking but merely a different and more effective way of getting heat into the paint film.

The concentration of the radiation falling on the work is of prime importance. This is determined by the wattage of the drying lamps, the design and efficiency of the reflectors and the distance from the lamps to the work. This intensity of the radiant energy is readily measured with a thermopile which is conveniently calibrated to read in terms of watts per square inch. Typical present day concentrations are given in Table I.

The effect of three different concentrations of energy upon the temperature attained in a typical paint film are shown in Fig. 1.

The energy absorbed by the work affects the temperature attained. This energy absorbed depends to a great extent on the reflection factor of the painted surface, that is, whether it is light or dark, red or green, smooth or rough. Fig. 2 shows typical temperature time curves for various colors. These curves show quite clearly the relation between temperature rise and reflection factor (or, conversely, light absorption) of the paint film. All other factors, then, being equal, black and other dark paints will bake faster than whites and light colors. The reflection factor of a painted film is not necessarily the same for infra-red radiation as it is for visible light, some paints absorbing considerably more in the infra-red than in the visible part of the spectrum. Some clue to the near infra-red reflection of paints can be obtained easily by photographic methods, since specially sensitized film is now available which is sensitive up to about 9,000 angstrom units. Such methods do indicate that the near infra-red reflection or absorption of common paint pigments is in general very similar to the reflection or absorption factors of visible red light.

The mass of the material being heated also exerts a marked effect on the temperatures attained, as shown in Fig. 3. These results indicate that the weight of the panel has more effect on the heating-up time than on the ultimate temperature reached, and on light sheet metal work, if the baking process lasts 20 minutes or longer, the mass of the material seems to have little effect on the final result. However, since most practical commercial baking schedules call for 10 to 15 minutes baking, the weight of the panel will have a marked effect on the result as most of the first 10 minutes or so is required to attain the working temperature.

The specific heat and the conductivity of the work are other factors involved as is also the heat loss from the work. This latter factor comprises low temperature radiation by the work, conduction to backing and supporting members, convection currents, drafts, etc. Drafts can chill the work appreciably and it is desirable to keep this loss at a minimum. It should be mentioned, however, that a certain amount of ventilation, either natural or forced, may be desirable to keep the concentration of volatile flammable material below a safe minimum value.

The paints best suited for use with present drying lamps are the synthetic enamels, lacquers, and synthetic lacquers. Until recently it has not been possible to bake satisfactorily the so-called high-bake synthetic enamels. Now that higher concentrations of energy are available it should be possible to bake almost any kind of synthetic enamel. Oil paints and oleoresinous enamels require considerable oxidation to effect satisfactory dry or bake and therefore cannot be so rapidly baked under the lamps.

Because of the lower heat absorption of white and light covered enamel, referred to above, it has been more difficult to bake these as rapidly as desired without modification of vehicle. It is quite possible, however, to bake such materials by heating the reverse side of the metal, and thus utilizing the higher absorption factor of the bare steel provided the work is of such a character that irradiation of the reverse side is possible or practical. In case the metal receives different coatings on the two sides, the radiant energy should if possible be directed to the side with the highest absorption factor.

In designing infra-red baking

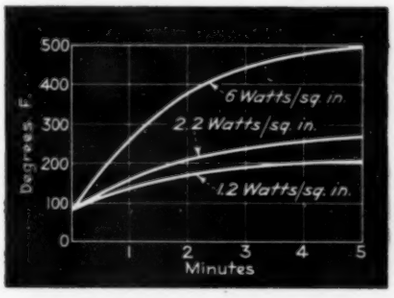


Fig. 1 — Time-temperature curves for black paint on 20 gage sheet steel, showing the effect of different energy concentration values on the temperature attained in a typical application

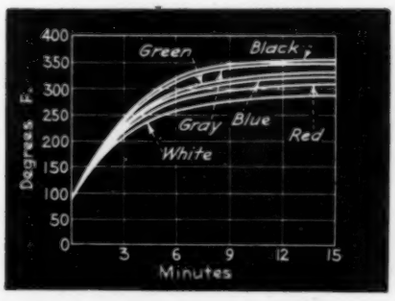


Fig. 2 — Temperature reached by the work during drying time varies with the color of paint; these data are for typical paints on 22 gage sheet steel under two watts per square inch

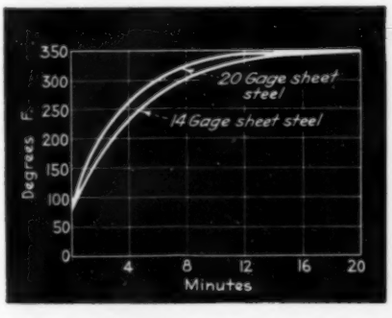


Fig. 3 — The temperature is also affected by the thickness of the panel on which the paint is applied, note the more rapid rise with the lighter material. These curves are for black paint under two watts per square inch

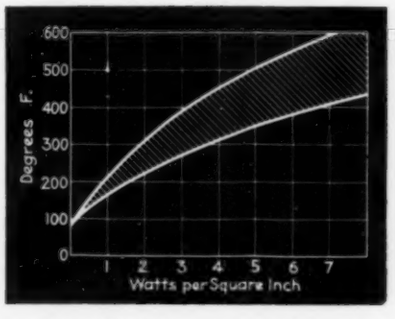


Fig. 4 — Shaded area in this chart shows range in temperature ordinarily attained wih various paints. Higher values are for blacks and dark colors on light gage stock, the lower figures for light colors and heavier material

equipment, it is desirable to take account of all the factors making for increased efficiency in the use of infra-red radiation. For example, the major part of the solvent in a paint film will evaporate spontaneously in a few moments so there is little to be gained by applying the radiation while this solvent is evaporating. At the other end of the operation it is possible to avoid forced cooling of the work by having the conveyor pass beyond the lamps, allowing the material to continue to bake with the heat energy stored in the metal and reducing the number of lamps required. Since only that part of the energy which is intercepted and absorbed can be useful in raising the temperature of the work, it follows that those objects which present a relatively large area to the lamps in proportion to their mass offer the most promising applications. Typical objects of this description are metal cabinets, automobile bodies, lithographings on metal and other coated flat stock. On the other hand, parts such as bicycle frames, mattress springs, and steel window frames, etc., would not appear to be well suited. Since the air in a radiant drying oven is not heated appreciably, it is necessary to arrange the conveyor carrying the work so that each piece receives the energy directly upon as large a part of the total surface as is possible. However, configurated parts such as flanges, etc., often will receive enough heat by conduction to bake them satisfactorily.

When drying paint on an insulating material, such as wood for instance, there will be almost no conduction of heat along the work and it becomes necessary to have a smooth distribution of the radiant energy. Because of the lower heat capacity and conduction of wood, paper, etc., a lower level of energy can be used to obtain satisfactory drying.

Of paramount importance to the prospective user of infra-red baking is the type of experimental unit needed to do the necessary ground work. Although a general idea of the installation can be obtained from the data given here, because of the tremendous range in finishing materials and schedules available, and the multitudinous requirements of the user, some actual experimental work must precede the design of an installation. In an experimental oven, it is desirable to duplicate closely the concentration of energy which will be used in the final installation. Furthermore, it is necessary that the infra-red bank be large enough to cover the sample. When the work is flat and small, or when a small section of a flat article can be taken, the minimum experimental bank may well consist of seven units—a centrally located unit surrounded by six other units, forming a hexagon.. With such a bank, the samples should not be much larger than the area of the central unit. The ideal experimental unit would be a section of the proposed tunnel or bank long enough to surround one of the objects to be finished.

The distance from the reflector to the work is, within certain limits, not too critical when the units are mounted in large banks or tunnels. In general, however, the closer the reflectors are to the work, the higher the intensity directly under the lamps, but the more spotty the resulting distribution of energy. Average intensity, however, is only slightly changed by close mounting beyond a certain distance. In practice, mounting distances of 6 to 18 inches are used, but these values apply only to large banks. The use of one or two lamps for preliminary testing seldom, if ever, yields complete information, and usually performance of larger installation is more satisfactory.

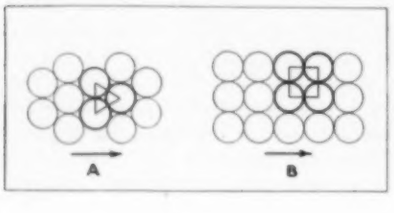
Table I—Typical Present-day Concentration of Radiant Energy

Average Watts per Square Inch On Work All lamps 12 inches from work, in gold plated reflectors* with edges touching.	
250-watt drying lamps in 12 inch reflectors	1.2
250-watt drying lamps in 9 inch reflectors	1.8
250-watt drying lamps in 8 inch reflectors	2.2
1,000-watt floodlight lamps operated at 750 watts in 12 inch reflectors	3.6
Summer sunlight, noon at sea level	0.7

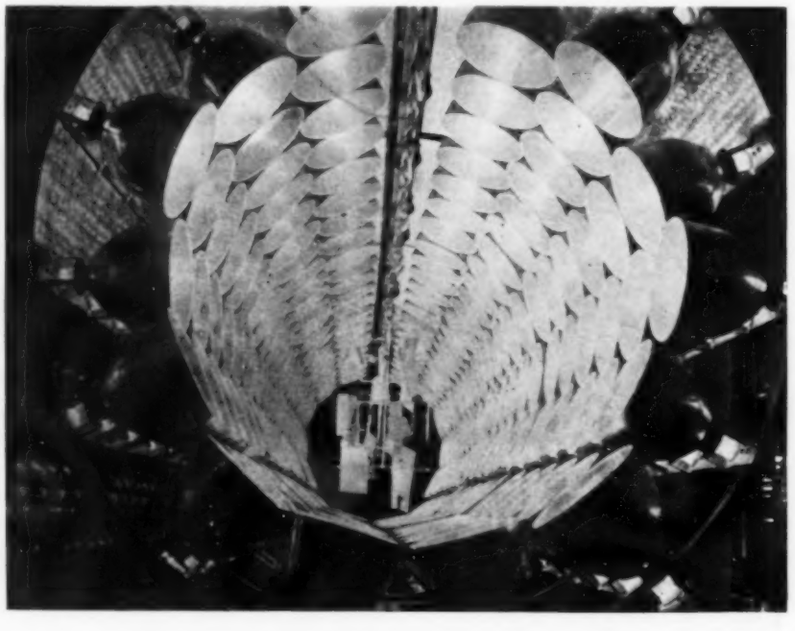
* The surface with the highest reflection factor for infra-red energy is gold plating. Although copper and silver plating are close to gold these metals tarnish quickly.

In conclusion, the radiant method of heating due to its advantages of low installation cost, speed, small floor space, better working conditions, and generally lower operating cost, will take its place with other methods of heating and will have many interesting applications.

Illustrating two methods of mounting drying lamp units. Method *A* gives approximately 15 per cent greater concentration of radiant energy than *B* and also gives smoother energy distribution on the work. Concentrations given in Table I are for method *A*



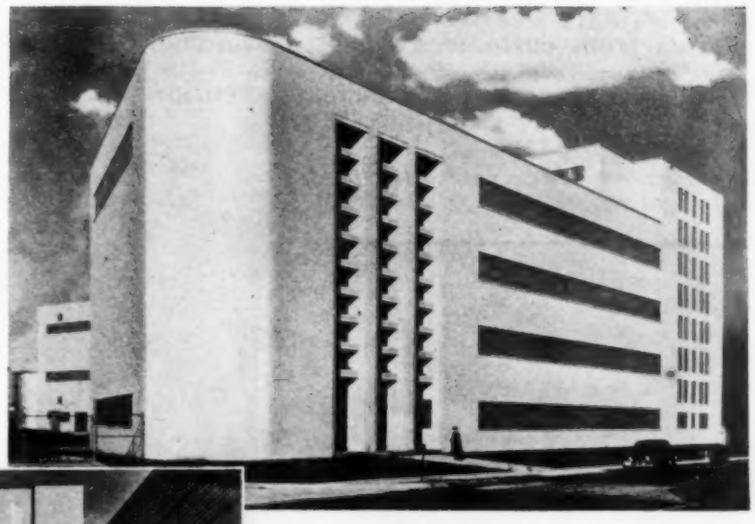
High-bake synthetic enamel on small metal parts is dried in 6½ min. by 336 250-watt lamps in this tunnel. Work reaches a temperature over 400 deg. F.

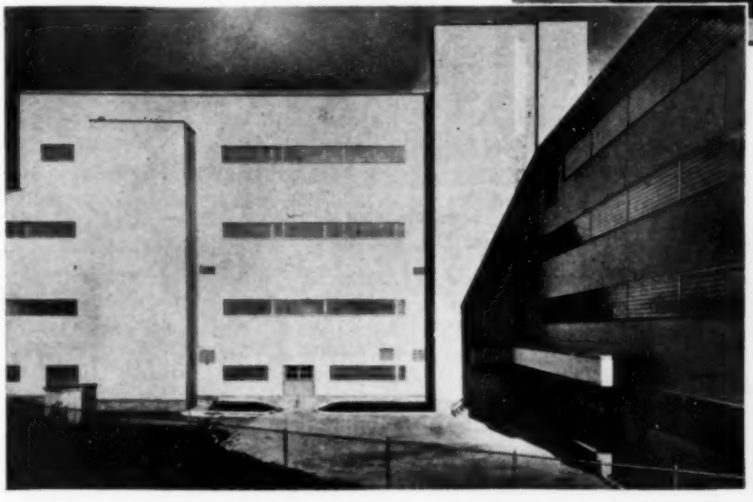


New Plant for Church & Dwight At Syracuse

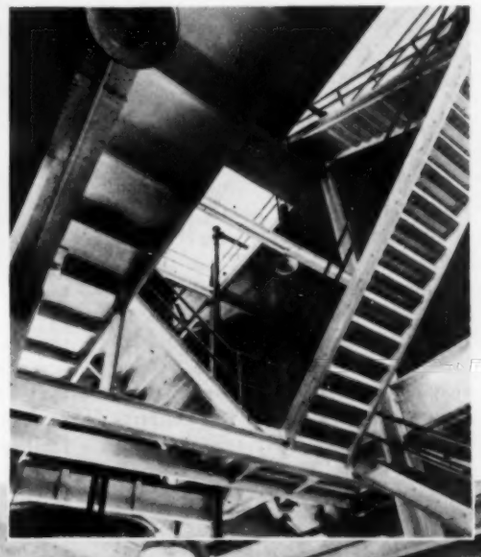
The new bicarbonate of soda refining and packing plant recently completed by the Austin Co., of Cleveland, for Church & Dwight Co., at Syracuse, N. Y., is a notable example of modern functional factory design. Built of electrically welded steel supporting brick walls containing large sections of glass brick for daylighting the interior, the plant is particularly well adapted to the air-conditioned cleanliness demanded by the process. At the right is the facade of the classification building. Below is part of the building housing the liquor, carbonating and drying sections

Photos supplied by the Austin Co.

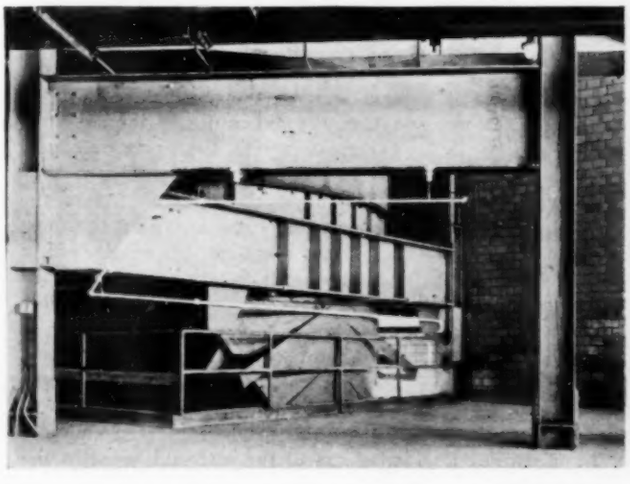


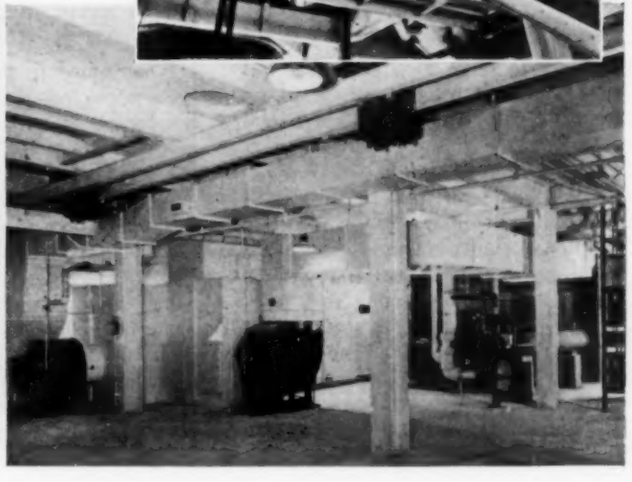


Ready accessibility to the processing equipment supported on welded steel framework is provided by numerous cleanly designed stairways and balconies, as shown in the view below



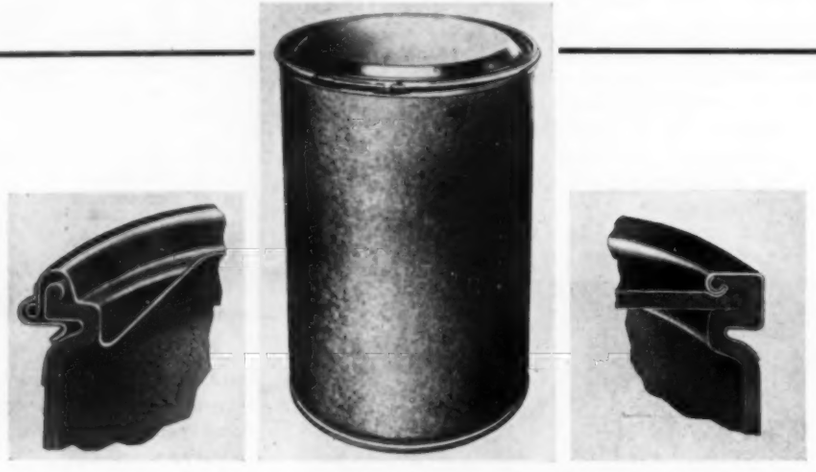
Below at the left is one of the huge welded steel bins for refined bicarbonate installed in the rounded corner of the classification building; and at the right, some of the Carrier air conditioning equipment in the basement, with circulating fans and air washers at the left, Freon compressors, condenser and motor control equipment at the right





Packaging the New Product

Chemicals and chemical products often present difficult problems of packaging; complaints from customers, losses and damage to material in transit may be eliminated to a large extent by sufficient attention to proper design of shipping containers.



Above is shown the new Leverpak fiber drum for fine chemicals, also details of construction; top chime, locking ring and cover shown at left, bottom at right

R. W. LAHEY
American Cyanamid Co.
New York, N. Y.

BY FAR the most critical period in the existence of any new product is the time of its introduction to the trade. Every detail relating to the product should have careful consideration as often some seemingly minor factor may prove to be a real aid in the effort to capture an important place in the industrial world. Such a detail is the proper choice of a container. There are instances on record where the container had been improperly selected, and damaged goods created an impression difficult to destroy.

The package should be selected not only to serve as a container but also to give by its appearance an air of distinction which will emphasize good features of the material and at the same time minimize any less desirable characteristics. Any sales department will quickly appreciate this, and a manufacturer may well be proud of his product if it arrives at its ultimate destination in a container which is clean, attractive, and easy to handle, open and empty.

The first and most important step in the development of a package is to determine what conditions the container will be expected to withstand in its travels. The protection afforded must be adequate to safeguard the product during storage at the factory, the dealer's warehouse, and the consumer's plant.

It is equally important that the package be so constructed that it will facilitate handling, storing, emptying and disposal. These features are receiving much attention in the design of small packages for products which are consumed in the home but have been neglected in the development of the larger or bulk packages. There are many possibilities for savings in the cost of handling, storing and emptying large containers if the package designer will give these factors proper consideration.

It is easy to state those properties which a good container must have, but it is difficult to ascertain the facts, especially if the material it is to contain has not been placed on the market. It is necessary to make many tests and, in order to be sure that all possibilities have been explored, an outline similar to that shown in the accompanying diagram may be used in development work.

It must be understood that this outline may be varied by the conditions and the type of product to be packed. If the product is to be introduced into a new field (to your company) in competition with materials manufactured by other concerns, it is usually safe to adopt packages that are similar in type to those used by competitors. One should not lose sight of the fact however, that sometimes these containers may be improved. If the new material could be introduced packed in a container that is more convenient for the customer, the difficulties of the sales department in establishing the material would decrease considerably.

The physical characteristics of the material to be packed play the most important part in the choice of a container. It is obvious that if the material is a liquid the possible packages are immediately limited to glass and earthenware bottles, carboys, metal cans and pails, drums and tight wooden barrels.

Does the product react chemically with any of the materials used in the

Sturdy new aluminum carboy which has recently been introduced; it is replacing glass, wood and steel containers for numerous liquids and chemicals

construction of the containers? It may be found that the liquid corrodes steel and it will then be necessary to find a special lining that will not be affected. It may be necessary to use galvanized or tin dipped drums or possibly wood or some metal other than steel. This same problem is sometimes encountered with lump or powdered materials when packed in jute, cotton, paper, wood or metal.

The matter of moisture absorption must have thorough consideration. This question is almost entirely confined to powdered materials as the containers which are used for liquids satisfactorily resist the transmission of water vapor. The absorption of moisture has a detrimental effect on many dry chemical products and comprehensive tests must be made before using a new container for a hygroscopic product.

Unfortunately there are no standard tests for moisture absorption so each manufacturer must devise his own. These tests can usually be worked out so as to utilize existing equipment and the type of experiments to be conducted depend on the product and the kind of containers under consideration. It is necessary that such tests give accurate pictures of the moisture protection afforded after the package has been subjected to transportation abuses. Some containers afford adequate protection in the manufacturer's warehouse, but after they have arrived at their destination, some or all of this protection has been lost.

Certain dry materials containing water of crystallization that are packed in non-rigid bags are likely to cake because of compression when stacked in warehouses. Materials of this character should always be tested for their tendency to solidify when subjected to the compression which they must withstand in storage.

The percentage of expansion and contraction of liquids, under extremes of atmospheric temperatures, should be determined and allowance made. If liquids freeze in extreme winter temperatures, the containers which are chosen must be able to withstand the stresses and strains of freezing and thawing.

It must be determined whether the new product is dangerous as defined by the Regulations for the Transportation of Dangerous Articles. If it proves to be in one of the dangerous group classifications, the Regulations contain a complete list of containers and their specifications which are authorized by law for shipments. It sometimes happens that it would be advantageous to use other containers than those authorized or to make certain changes in the approved construction of these containers. Such changes can be made, but from six months to more than a year is required to obtain approval of a new package for shipping dangerous articles. In order that introduction of the new product will not be deferred too long the application for change should be filed as promptly as possible.

Fitting the container to the facilities of the producing plant is largely a production problem. The choice of filling equipment depends on the production machinery and the type of container to be used. Often by the use of a little ingenuity, existing equipment can be altered to meet new filling conditions.

Chemical industry is gradually adopting the practice of packing in even weights. This is to be commended. The packing cost is a little higher, but the savings in inventory records, billing, and handling of orders will more than make up for this increase. Besides, it is a great convenience to the customers to receive raw materials in even-weight packages.

Many chemical plants are located close to water where the atmosphere is very humid. This, combined with corrosive fumes, presents a formidable problem in maintaining a presentable finish on containers in storage. Atmospheric corrosion tests should be made on any new paints, coatings or new container materials otherwise a large number of containers may have to be scraped and repainted before shipment.

If the material is packed as produced, consideration must be given to the handling and storing conditions and the equipment used for this purpose. This involves several questions such as how the packages are conveyed to the warehouse, how the packages are stacked and so forth. Many chemical products are stored by production batches and samples must be taken from time to time to be analyzed by customers before purchasing. Containers for such products must be readily opened and resealed. Sometimes products must be repacked into smaller units in the warehouse and ease of opening and resealing is important.

Costs ordinarily play a large part in the choice of containers. It is often proper to pack relatively inexpensive products in cheap containers, but even this principle has exceptions. Physical and chemical properties of many materials in the lower price classifications are such that they cannot be shipped in low cost containers. It is therefore obvious that the cost factor can only be applied after those containers which are unsatisfactory have been eliminated. Cost should then receive the same detailed study that it does in the other functions of business. Cost must never be considered from the standpoint of container only. The related costs, such as comparative handling, storing, transportation or difference in tare weights, dispensing and resale value of containers must be taken into account along with the purchase price.

Consideration should be given to the structural strength which must be built into the container in order to insure the arrival of the product

at its destination in satisfactory condition. Containers which are adequate for rail shipments may be too weak for marine transportation. Containers which are adequate for carload movement may not be rugged enough to stand less than carload movement. Truck and express shipments all involve different handling conditions. The distance to be travelled must also have consideration. Freight movements even by carload, where the haul is as much as 1,000 to 3,000 miles may require several switching movements at junction points. This type of transportation is much harder on the lading than movements of only a few hundred miles.

Present railroad practice of greatly increased speeds for freight trains, greater number of cars per train and shorter switching time has presented a serious problem to all shippers in the last few years. In many cases the strength of packages has not been proportionally increased and those shippers who have not had a considerable margin of safety in structural strength of their containers have been encountering a greater number of cases of damage in transit.

It is recommended that after the type of container has been decided upon, tests be made to determine what strength must be built into this type of package in order that it will be capable of resisting transportation abuses. Factory tests should first be made in the form of drop tests or other adequate tests in comparison with some container which is known to suffice in similar transportation service. The result of this will indicate which containers will probably prove satisfactory, but it should be realized that the findings are only comparative. Shipping tests are the only conclusive tests. The purpose of the factory tests is to narrow the field by eliminating containers which would prove unsatisfactory. No two shipments receive absolutely identical treatment and an effort should be made to cover all possible shipping conditions.

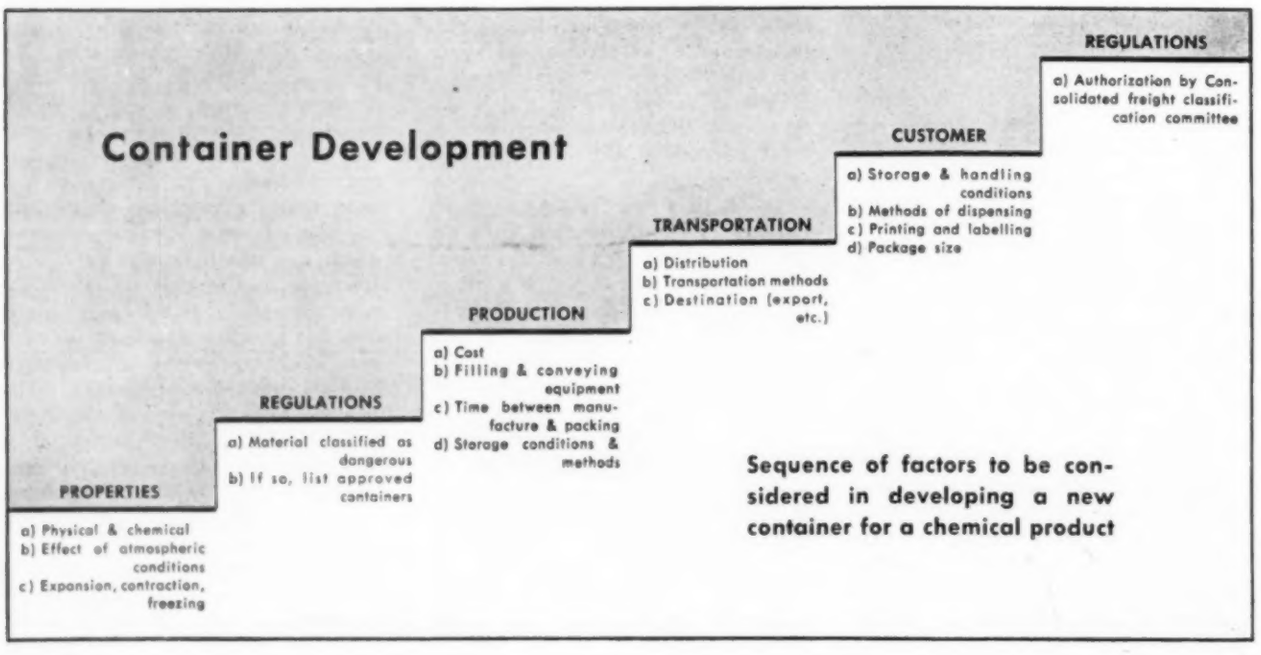
Consideration of the package from the standpoint of the customer is the particular part of the investigation which is of vital interest to the sales department. A little extra convenience to the customer in the handling or dispensing of material from the container will give a sales advantage which means much in the introduction of any new material.

A study should be made of average customers' warehousing, handling and using conditions, and equipment preferably in their plants. Particular attention should be paid to methods of emptying the container. In some chemical users' shops the floors are wet, in others the air is full of steam and some customers store their raw materials outside. These are some of the conditions that must be considered.

It may be found that the majority of customers use a specified amount of material at a time and this should be a guide in determining the size of the package. More often, however, no uniform practice can be counted upon and then the handling conditions and cost should be considered in conjunction with the average customer's choice of size.

There are many methods employed in dispensing materials from containers. Some are entirely emptied while the material from others is doled out in small portions. Some customers have emptying equipment such as pipe and faucet fittings, racks, tilters and suction pumps for emptying carboys and drums. The new container must be so constructed that this equipment can be utilized or similar apparatus which will fit the new package must be supplied to the user. Consideration of this problem at times will lead to the discovery of some advantageous feature for the dispensing of the material. An interesting example of this is the patented head for a tight barrel devised by Proctor and Gamble where the product can be removed through a small opening without taking off the head of the barrel. This tends to minimize contamination. Another example of this is the use of a colored thread in the top sewing of the valve multiwall paper bags which when pulled opens the bag.

If, as in the synthetic molding powder trade, the molders use small amounts of powder at a time and contamination is costly, the container should have an opening which is easy to remove and reseal. The full open head fiber drum containing this feature has become the most popular container in this field.



Sequence of factors to be considered in developing a new container for a chemical product

If it is not evident just how to handle, care for, or open the new container, instructions should be printed in a prominent place.. Workmen are notoriously rough on equipment and materials so it is advisable to make their tasks as simple as possible. The experience of a certain manufacturer illustrates this. His product was shipped in a steel drum, the friction cover of which was completely soldered to the head. It was easy to remove the cover by tapping with a hammer and then cutting the solder by holding a cold chisel at the proper angle. Unfortunately, no directions were placed on the drum when it was first introduced and many complaints were received regarding the difficulty in opening. Some reports stated that the heads of the drums were cut in the efforts to open the covers. This led to the placing of a small label on the cover giving simple opening instructions and henceforth no complaints were received. This illustrates the importance of a seemingly minor detail which was overlooked in the introduction of a new package.

Containers for dangerous materials must be properly cared for and they must be emptied carefully or serious accidents may result. In recognition of this, the Manufacturing Chemists' Association have recommended the use of standard labels which have been prepared for flammable and corrosive liquids. The M. C. A. has a set of working regulations for the guidance of customers in handling, storing and emptying dangerous liquids. The importance of displaying these precautions is obvious.

Users of this heavy duty paper bag appreciate the easy opening feature.

A good clean attractive package makes a worthwhile impression on customers, and although it is not mentioned, they unconsciously note these qualities. An effort should be made even on bulk packages to make them attractive and distinctive in appearance. This can be done by shape, color and design often with the help of attractive labels. If necessary, the decoration can include a set of directions for the use of the material.

Containers which carry non-dangerous articles must meet the specifications of Consolidated Classification Committee Rules No. 40 and No. 41 and the particular commodity must be authorized to be shipped in the specific container adopted.

Export shipments present a somewhat different problem in that certain additional factors must be considered. Of course the transportation hazards are much greater and this should be taken into account in the structural strength of the containers. Import duties also play an important part in the choice of packages since in some countries duties are based on gross weight and therefore the tare weight must be reduced to a minimum.

The habits, customs and methods of handling in foreign countries are all different and these questions also influence the type of container chosen. If the volume is sufficient it will probably prove advisable to use a different container for export shipments, otherwise the cost of a package which is satisfactory for export shipments would be too expensive for the domestic market.

These seemingly detailed investigations which have been suggested are entirely warranted. Many manufacturers have had the experience of shipping a material in an inadequate container and therefore realize the large losses which can result. The choice of a proper container is just as important as the development of the manufacturing process for a new product and the maintenance of its quality. The many large losses which industry has suffered through the use of unsatisfactory containers can and should be averted with the same careful investigation which is used in the development of the product.

Transportation of chemicals in motor truck tanks is on the increase. The American Cyanamid and Chemical Corp. has recently placed two truck tanks of the type shown in the accompanying illustration in service for handling a corrosive solution. These tanks have a capacity of 2,500 gal. each. They have been designed with safety uppermost in mind. The unusually low center of gravity of the tank may be noticed. It has been lined with rubber by the B. F. Goodrich Co. using the Vulcanlock process of adhering rubber to metal and the Triflex method of construction. The tanks are built on a special trailer.

Process Equipment NEWS

Machinery, Materials and Products

Diesel Driven Compressor

CHICAGO PNEUMATIC TOOL CO., 6 East 44th St., New York, N. Y., has announced the development of the Class W-CO stationary diesel-driven two-stage air compressor, available in capacities from 662 to 2,000 c.f.m. for pressures from 80 to 125 lb. Operating cost at a small fraction of that for electrical operation is claimed. Compact and simple design is used and high compression efficiency claimed owing to effective inter-cooling and large valve area. Direct transmission of power from engine to compressor eliminates intermediate losses. A direct injection fuel system, conservative speed and power ratings, and ready accessibility of all parts are other features.

Cutting Type Grinder

A NEW TYPE of construction in a cutting-type grinding and granulating machine has been developed by the Cumberland Engineering Co., Kingsport, Tenn. The machine is compact, simple and rugged and is stated to have a large capacity in proportion to its size and cost. The construction consists of a heavy shaft supported on a double row of ball bearings and provided with a heavy flywheel, with shaft and flywheel inclosed in a casing. Overhung from one end of the shaft is the grinding head in which is a heavy rotor carrying two to four knives. The lower half of the grinding chamber is provided with a discharge screen and the entire periphery is provided with a ring of short stationary knives equally spaced at one end of the cutting chamber. A stationary mangling knife attached to the machine end casing and extending across the width of the screen partially reduces material as it enters the cutting chamber.

This partially reduced material is crowded into the region of the ring of stationary knives where most of the cutting takes place. Owing to rapid agitation of the material, the finer particles move out towards the screen and sift through. Special features include stainless steel screens, knives ground at a less acute cutting angle to protect against chipping and rapid dulling, and the use of labyrinth seals to protect the bearings. Materials handled include plastics, fibrous materials, grains of all kinds and numerous chemicals, seeds, seed cakes, etc. Four sizes for capacities as high as 300-1,000 lb. per hour are available.

Electro-Deposited Screen

CULMINATING several years of development work, the C. O. Jelliff Mfg. Corp., Southport, Conn., has announced commercial production of Lektromesh, a type of perforated metal screen produced by electrodeposition which can be made in copper or nickel-plated copper in meshes from 25 to 400. For applications particularly subject to abrasion, the material may be plated with chromium.

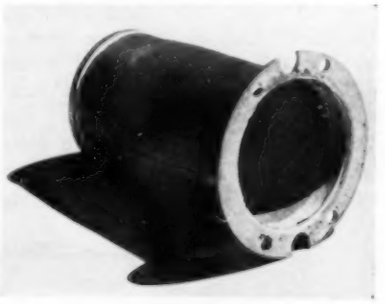
In comparison with woven wire screen, the new material is much stronger, smoother, and can be made readily with solid areas if gasketing is to be used to seal a screen or strainer in place. Small fuel strainers can thus be made in multiples in sheet form and punched from the sheet. The new process is a continuous one, producing screens in widths up to 36 in. at rates up to 40 in. per hour. Copper is first plated on a rotating cylindrical cathode consisting of nickel conducting areas within which are non-conducting "islands" to form the holes of the finished product. At present the continuous process is applied to meshes in the range from 25 to 150 while a batch process is used for finer screens.

(A feature article to appear in an early issue of *Chem. & Met.* will describe the process in detail.—Editor)

Electric Process Kettles

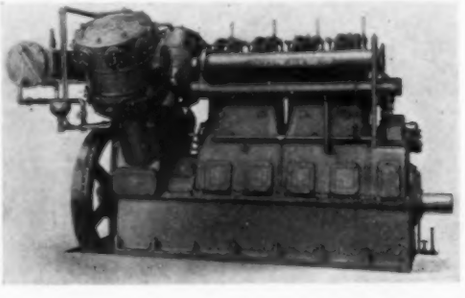
PATTERSON FOUNDRY & MACHINE CO., East Liverpool, Ohio, has announced a line of electric process kettles equipped with the new Flasheat electric heating element recently announced in these pages (Oct. 1939, p. 647). Greater heat concentration per unit area, higher efficiency, more rapid heat-up and easier replacement of elements are claimed for the new arrangement. These kettles

Nickel screen formed of Lektromesh

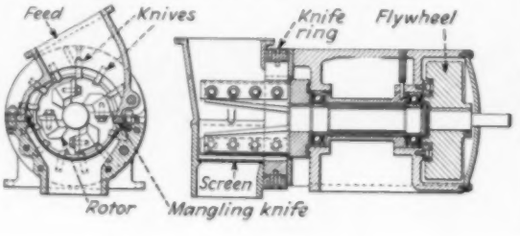


Courtesy International Nickel Co.

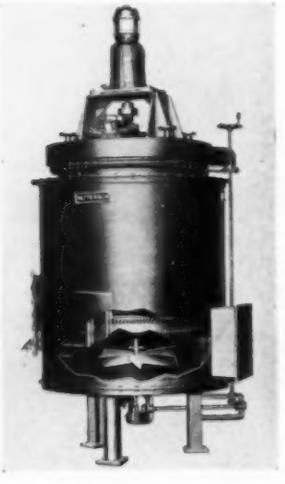
New diesel-driven compressor



Cross section of Cumberland grinder



Electric heated process kettle



permit quick water cooling, as well as faster heating, thus shortening process cycles, according to the manufacturer. Such kettles are available in a variety of metals.

Jar Filler

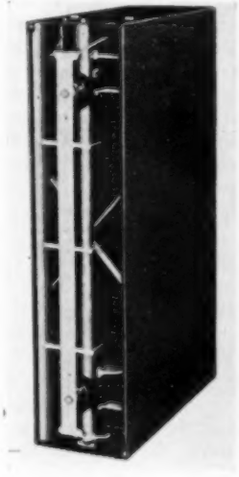
SPRAGUE-SELLS DIV. of Food Machinery Corp., Hoopeston, Ill., has announced the recent development of an interesting type of jar filler for handling a pharmaceutical product of the consistency of petrolatum. Previous difficulty in filling this product had been experienced owing to slight variations in the cubic capacity of all glass jars. Slight variation would cause over-filling of some jars and slack filling of others. It was discovered that the material melted and flowed freely at exactly 116 deg. F. A special blower heater was developed for raising the temperature of all parts of the machine including the valves to 116 deg. at the beginning of operation each day. A closed hot-water heating coil was also provided for maintaining this temperature. A special type of valve is used to fill exactly to any desired level without drip. The user has consequently been able to dispense with an inspection belt for the wiping of overfilled jars. The filler is provided with a variable speed drive and is adjustable for various size jars.

Sprague-Sells 12-valve jar filler

Electrostatic Air Cleaner

IMPROVEMENTS in its line of Precipitron electrostatic air cleaning equipment for commercial and industrial use have been announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. In the redesigned line, two sizes of cell have been adopted as standard, one having an effective cross section 8 in. wide by 18 in. long, with a cleaning capacity of 375 c.f.m. and the other an 8 by 36-in. cell with twice the capacity. At 300 c.f.m. the smaller has a guaranteed efficiency of 90 per cent, with the same efficiency for the larger at twice the capacity. Grouping of these cells provides for any desired air cleaning capacity. Power packs available in two standard sizes are made for the handling of up to 50 cells of the larger size. Both types operate on 115 volt, single-phase a.c. lines.

Westinghouse electrostatic air cleaner

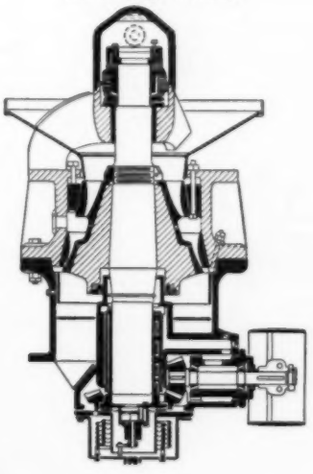


Portable Submersible Pump

MARKETED under the name of Sawyer Smithway by Sawyer Electrical Mfg. Co., Los Angeles, Calif., is a new portable submersible pump having a capacity of 220 g.p.m. at 25 ft head At 90-ft. head, the capacity is 60 g.p.m. The overall length of the pump is 21 in. and overall diameter, 6¼ in. The weight, less foot valve and cable, is 80 lb. A standard Sawyer two-pole polyphase motor, which is claimed to cut weight and overall dimensions nearly 50 per cent, is employed. Operation either submerged or unsubmerged with a foot valve attachment may be employed. The pump motor is water jacketed to facilitate cooling.

Sawyer Smithway portable submersible pump

Multi-stage crusher



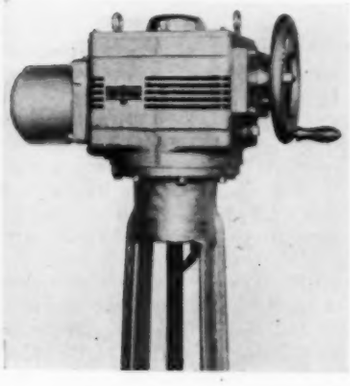
Multi-Stage Crusher

A MULTI-STAGE, fine-reduction crusher of the gyratory type, known as the Traylor-Stearns, has been announced by the Traylor Engineering & Mfg. Co., Allentown, Pa. In the new machine the crushing head comprises two separate manganese steel bell-head mantles of different diameters, assembled one above the other with a common head center and having a suitable spacer plate between the two. The concaves, of which there are two, are of this company's curved design, each matching a part of the composite head. The discharge opening of the upper stage is independently adjustable. It is claimed that the machine will not pack in either stage at any setting. Hence more efficient application of power is claimed, with lower cost per ton in fine reduction work and increased capacity. Production of a cubical product without slabby particles and with a minimum percentage of oversize is claimed.

Valve Operator

A DUST-TIGHT weather-proof motor-driven valve operating device which is bolted directly on top of the valve yoke has been announced by Cutler-Hammer, Inc., Milwaukee, Wis. Designated as Bulletin 816, the new unit employs thrust springs to compensate for thermal expansion and contraction of the valve stem, a simple jaw clutch for coupling the operator to the yoke nut, oil-immersed gear reduction and a high-torque reversible motor. The handwheel for manual operation is normally disengaged.

New valve operator



Equipment Briefs

BOTH PORTABLE and stationary models are available in a new high-pressure cleaning jet recently announced by William Sellers & Co., Philadelphia, Pa. This machine includes a 50-gal. solvent tank, yet occupies a space of only 18x30 in. The heart of this equipment is a mixing chamber into which water is admitted and then steam which, condensing, draws in detergent. From an initial steam pressure of 25 to 100 lb., a jet pressure of 50 to 200 lb. is said to be obtained for cleaning machinery, coils, floors and stairways, of dirt, grease, tar and asphalt.

WILSON WELDER & METALS CO., 60 East 42d St., New York, N. Y., has

announced a new single-operator, motor-generator arc welder requiring only one control device for operation. Known as the Wilson "Hornet," this welding machine employs only a single simple handwheel for control. An infinite number of current settings may thus be secured. Accidental polarity reversal is said to be impossible, while a uniform arc is claimed to be produced at all times. 200, 300 and 400 amp. sizes are available.

AN EXPERIMENTAL model of the Webcell continuous dialyser, originally described on page 39 of our January 1938 issue, and made by the Brosites Machine Co., 30 Church St., New York, N. Y., is now available constructed from duPont's Lucite transparent plastic to permit observation of operation. The dialyser is used for the recovery of soluble salts and the purification of solutions. Membranes of Cellophane, parchment or other suitable materials are used. The experimental dialyser has a direct relation in capacity to production-size machines made by this company so as to permit ready estimation of full-scale operating results.

A NEW 20-g.p.m. rotary pump for direct connection to a standard 1,800 r.p.m. motor has recently been announced by the Blackmer Pump Co., Grand Rapids, Mich. This pump, suitable for pressures up to 100 lb. and for the handling of any clean liquid, is built in three standard constructions including all iron, bronze fitted and all bronze. Like other pumps made by this manufacturer, the pump is a positive displacement type, compact, self-priming and quiet in operation. Standard bases and direct-connected motors in sizes from ¼ to 3 hp. are available.

Homogenizing Unit

A RECENT DEVELOPMENT of the Marco Co., Philadelphia, Pa., is the Kom-bi-nator, a combination homogenizer and grinding unit with interchangeable heads which is claimed to accomplish better and more uniform dispersion and disintegration than earlier equipment. The homogenizing head, used for homogenization, dispersion, compounding and blending, consists essentially of a pair of hydraulically balanced rotors, a pressure chamber and a rotary valve with inner and outer ribs. These parts are so placed that homogenization is accomplished in progressive stages of compounding, restriction, sheeting and impacting. In the grinding head, developed primarily for disintegrating, pulping, extracting and grinding, materials to be processed are passed under desired pressure and clearance between a grinding stator and a shearing rotor which are mirror images of each other. Both stator and rotor are grooved radially. Reductions in particle size to as fine as 1 micron are claimed, the size depending on the material characteristics. A jacket for heating or cooling the grinding head is provided.

Kom-bi-nator homogenizing and grinding unit

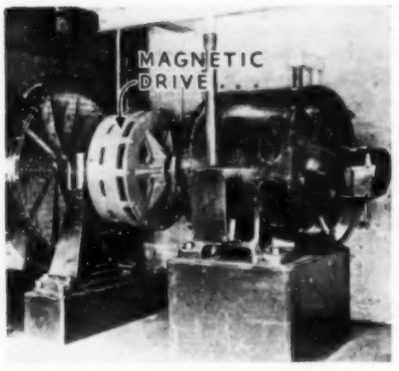
Hand-aspirated psychrometer

The machine is compact, ruggedly constructed and simple mechanically. No accessory pump is needed. Stainless metal construction is used in contact with process materials. The manufacturers recommend the machine for applications in mixing liquids with liquids or solids with liquids. Typical uses include the manufacture of emulsions, waxes, textile soaps, printing pastes, vat dyes, pharmaceuticals and cosmetics.

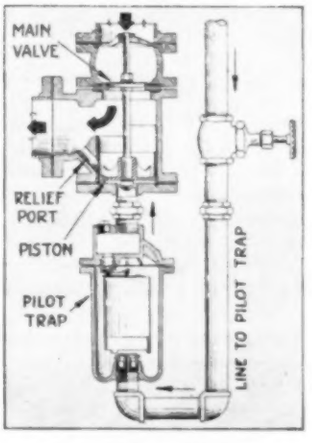
This company has also introduced an all-purpose gear-type sanitary pump provided with a compensator plate for automatically compensating wear between the rotors and the stationary parts of the head. Adjustment for tooth wear is also possible. These pumps are built in capacities from 900 to 2,700 gal. per hour.

Magnetic Drive

A NOVEL variable-speed drive method using electro-magnetic principles for torque transmission has been developed by Electric Machinery Mfg. Co., Minneapolis, Minn. This drive is a rotating device to provide controllable, variable speed. It is placed between a constant-speed driving motor and the load. Speed is controlled by turning a small control rheostat knob which adjusts a small a.-c. current supply to a magnetic flux producer connected to the driven machine. A flux linkage ring driven by the driving motor surrounds, but is not in mechanical contact with, the flux producer or magnet. Depending on the



Magnetic variable speed drive



Large capacity steam trap

strength of flux produced by the magnet, the latter slips more or less with respect to the ring and hence transmits a controlled variable speed. The slip loss in this drive is proportional to the slip and heat so generated is dissipated in the ring member of the drive, which is self-cooled.

Hand Aspirated Psychrometer

A RECENT ANNOUNCEMENT of Julien P. Friez & Sons, Division of Bendix Aviation Corp., Baltimore, Md., describes a new hand-aspirated psychrometer of pocket size with which relative humidity measurements may be made while holding the instrument stationary and forcing typical air at the correct velocity over the thermometer bulb by means of a hand pump. The thermometers are shielded against radiation errors and constant accuracy is claimed. A slide rule for determining relative humidity from the thermometer readings is included in the folding plastic case.

Giant Steam Trap

A STEAM TRAP with 6-in. pipe connections and continuous flow capacity for 300,000 lb. of water per hour at 50 lb. pressure has been announced by Armstrong Machine Works, Three Rivers, Mich. First built for draining sugar refinery evaporators, the trap is now offered for a variety of purposes. As

shown in the accompanying diagram, the new unit consists of a large inverted bucket type pilot trap and a piston-operated main valve. The pilot trap is so connected to the drain line as to keep the main valve sealed with water. When there is sufficient condensate to open the pilot trap, it discharges against the piston of the main valve, forcing it upward until the relief port is uncovered. Snap-action closing takes place when steam instead of water enters the pilot trap, causing it to close.

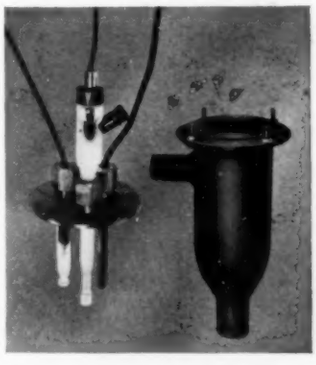
High-Temperature pH Electrode

FOR CONTINUOUS OPERATION at temperatures between 122 and 212 deg. F., the National Technical Laboratories, 3330 East Colorado St., Pasadena, Cal., has developed a glass electrode for pH measurement which is designed for installation directly in tanks and grounded flow lines without stray current effect. It is claimed that the unusually high temperature range of this electrode assembly required the development of an entirely new type of electrode glass. The assembly includes the glass electrode proper, the calomel electrode, and a temperature compensating tube, all mounted in a corrosion-resisting porcelain-enameled flow chamber.

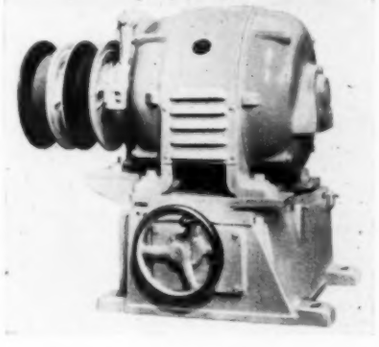
Variable Speed Drive

A NEW MULTIPLE-BELT TYPE variable speed drive motor consisting of motor, special base and variable-pitch V-belt sheaves, has been introduced by U. S. Electrical Motors, Inc., 200 East Slauson Ave., Los Angeles, Calif., and 80 34th St., Brooklyn, N. Y. Speed changes are effected by turning the handwheel which shifts the motor on the base and so moves a yoke which actuates the pulley.

High-temperature pH electrode



Multiple-belt variable speed drive



Creosoting Cylinders

WHAT is claimed to be one of the longest all-welded unfired pressure vessels ever manufactured in the United States is a 160-ft. by 6 ft. 1-in. diameter creosoting cylinder, recently delivered by the Treadwell Construction Co., 618 South 12th St., Midland, Pa. The fabrication of this vessel was stated to have been made possible by special welding procedure perfected by this company. A close-up of the weld, as well as a detail of the special end closure is shown in the insert in the accompanying view. The vessel, fabricated to A.S.M.E. and A.S.T.M. requirements, is made of $\frac{5}{8}$ in. steel with $\frac{7}{8}$ in. head and weighs 111,000 lb. Four railroad cars were required for its transportation.

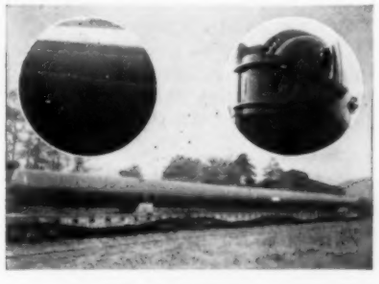
Car Puller

AN IMPORTANT ADDITION to the line of car-pullers put out by Stephens-Adamson Mfg. Co., Aurora, Ill., is the new No. 14 wire-rope car puller with horizontal capstam which has recently been announced, Although it has a capacity of six fully loaded freight cars, the new puller is of extremely compact construction. The drum will accommodate 500 ft. of $\frac{5}{8}$ in. wire rope. A heavy duty clutch, operated by a handwheel, disengages the drum to pay out rope.

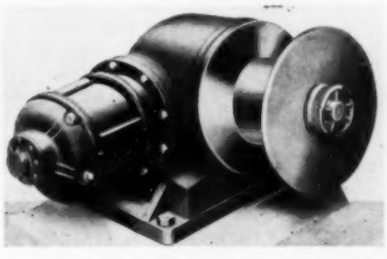
Optical Pyrometer

AN ENTIRELY NEW type of optical pyrometer which uses the potentiometric method of measuring the current supply to (and hence the temperature of) the hot "disappearing filament" has been developed by Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. The instrument is calibrated directly in degrees and is said to be easier to use and more accurate than earlier types of optical pyrometer. It consists of a strap-supported potentiometer and a telescope which, when not in use, is carried in a loop attached to the potentiometer. In use the telescope is sighted on the hot body (1,400-5,200 deg. F.). Grasping the telescope automatically closes a switch and causes the filament to glow. A large knob on the potentiometer is then turned until the glowing filament blends with the object sighted. This produces a rough adjustment of the potentiometer. Turning another knob then brings the potentiometer into final balance and shows the correct temperature on a scale exposed in a window.

160-ft. creosoting cylinder



New wire-rope car puller



Small Molding Press

F. J. STOKES MACHINE Co., Olney P. O., Philadelphia, Pa., announces the development by the Standard Machinery Co., Mystic, Conn., of a new 20-ton molding press, similar in construction to the 50- to 300-ton presses previously announced by this company. Intended for small production and experimental work, the press is of the combination toggle and hydraulic type, designed for quick opening and closing. Control is accomplished through a single lever. A model designed for air operation at 125 lb. pressure is also available.

High-Pressure Trap

FOR USE in discharging liquid products obtained in the hydrogenation of coal at pressures up to 5,000 lb. per sq.in., the Strong, Carlisle & Hammond Co., Cleveland, Ohio, has recently delivered to the U. S. Bureau of Mines a special type of trap designed for resistance to extreme pressure and to ammonia and hydrogen sulphide. Despite the special character of the trap, various parts were standard with this company for non-special traps.

Flow Rate Indicator

A DIFFERENTIAL pressure indicator for rate of flow and liquid level which operates without the use of mercury or other liquid has been introduced under the designation of No. 98 by Morey & Jones, Ltd., 922 South Hemlock St., Los Angeles, Calif. When used as a flow indicator the differential pressure produced by the orifice or other primary device is balanced by a calibrated bellows unit which moves in direct relation to the pressure applied. This movement is transmitted to a pointer and indicated on a scale. The instrument may be calibrated for any differential pressure range between 0-30 in. and 0-225 in. w.g. Permanent calibration is said to be assured. The instrument need not be accurately leveled and may be transported without loss of adjustment.

Your Plant NOTEBOOK

FALLACY OF OVERSIZE STEAM MAINS FOR PROCESS STEAM SUPPLY

By JAMES O. G. GIBBONS
Mechanical and Electrical Engineer
Bloomfield, N. J.

IN LAYING OUT mains for process steam, there are two somewhat prevalent fallacies which should be avoided, the first being that loss of pressure necessarily involves an appreciable loss of heat, and the second, that large steam mains act as effective steam reservoirs.

When high pressure steam is supplied to an engine, even when operating non-condensing, the pressure loss may be from 85 to over 90 per cent of the initial pressure of the steam, yet the percentage of heat converted into mechanical energy will be well under 10 per cent, so that the exhaust steam does not contain so very much less heat than the live steam.

Where there is no engine or other steam operated power equipment, the only part of the heat converted into mechanical energy is that required to overcome the resistance or friction of the pipe, and not only is this practically negligible, but as a rule, it is more than compensated for by decreased radiation in the case of smaller diameter pipes.

From this it may be inferred that, within reasonable limits, the smaller the diameter of the steam mains, the better. It will generally be found that for mains of not over 15 in. diameter, a steam speed of 1,000 ft. per minute per inch diameter of pipe will be quite satisfactory. For instance, the velocity in a 10-in. pipe may be 10,000 ft. per minute.

The assertion is often made that the processes are not getting enough steam, on account of the small size of the steam lines, but except in those rare cases where a few pounds less of pressure cannot be permitted, this is hardly ever true, the real trouble being that the boiler is not generating steam as fast as it is being called for. The only accomplishment of large steam mains is to make it possible for careless operators to make excessive demands upon the boiler, thus aggravating the trouble.

One sure check on this is to see how the pressure is holding at the boiler. If it is down, the trouble cannot be cured by increasing the size of the steam mains; on the other hand, if it is not down, it is not likely to be badly down anywhere else.

Of course, if one of the processes is being served by a large main, and another by a small one, the former may be getting more than its fair share of the steam, but that is a question of relative, rather than absolute pipe sizes.

This situation is an important one to watch, as intelligent planning and careful operation will often enable the boiler to carry the load, when it has hitherto been falling down under excessive peak demands.

With regard to the accumulator capacity of large steam mains, it must be remembered that even with the largest mains, no steam can be drawn from them without a drop in pressure. The amount of steam available to make up a sudden deficiency is that due to the lessened weight of steam which the main will hold under the reduced pressure. For instance, a 12-in. main, 20 ft. long, will contain less than 15¾ cu. ft. of steam which, under 100 lb. gage pressure, will weigh about 4 lb. If we withdraw steam so that the pressure drops to 90 lb., we shall have the same volume of steam in the pipe, but it will weigh about 3¾ lb., so all the extra steam we have taken is only about ¼ lb., which is hardly worth considering.

One point may be misleading, namely, that when we let the pressure drop, some of the hot water in the boiler will flash into steam. The mistake must not be made of crediting this extra steam to the large size of the steam mains.

Increasing Fan Capacity

How a large fan operating at high temperature on corrosive fumes was increased in capacity by speeding up above the critical speed which the original lining could stand was told in a recent issue of *The Neoprene Notebook*, published by the Rubber Chemicals Division of E. I. duPont de Nemours & Co., Wilmington, Del. This fan, a large, expensive one lined with lead to resist the action of fumes containing H_2SO_4, SO_3, SO_2 and water vapor at temperatures from 180 to 190 deg. F., became too small when the plant using it had to step up production. The engineers in charge were faced with the problem either of replacing the fan at a considerable capital investment, or of increasing its speed. However, it was found that the necessary speed increase would require running the fan at a rate greater than would be safe for the lead lining.

The corrosive conditions of operation were so severe that a piece of ¼-in. steel would be eaten away in a few weeks. It was therefore out of the question to install equipment without a protective coating of some kind. Various materials were considered with the final decision to try a covering of neoprene.

That the experiment was successful is attested by the fact that the fan has now been in continuous operation, 24 hours a day and 7 days a week for over 14 months and the coating is still in excellent condition. During the time of operation the fume inlet temperature is stated to have been almost continuously in the range between 180 and 190 deg. F.

Simple Brand for Carboys

Monsanto Chemical Co. reports that Ed Kassing, foreman of the company's warehouse and shipping department at Monsanto, Ill., has developed a new branding device for marking the hundreds of carboy boxes that are handled through his department. Kassing worked out the idea shown in the accompanying illustration because he felt that too much time was wasted in heating and reheating the brand separately for each box. The brand is raised slightly and held in position by a pin so as to come within the blowtorch flame. Then the pin is removed, the brand lowered to mark the box and raised again to heat while the operator moves on to the next box. Results are good and operation easy.

Modern Sugar Refining

THE CANE SUGAR REFINING INDUSTRY in the United States consists of a few large mills, for the most part located in the centers of population on the Eastern Seaboard. Most of them use the standard bone char process, while a few in the South use the relatively new process of decolorizing with activated carbon.

A refinery was put in operation in 1936 at Brooklyn, N. Y., by the Sucrest Corp., a subsidiary of the American Molasses Co. Since the building of their refinery, Sucrest has developed and adapted a new process in which no bone char or activated carbon is used, and all usual filtrations have been reduced to a single polishing filtration. The system has been reduced to a minimum of operations with considerable economy.

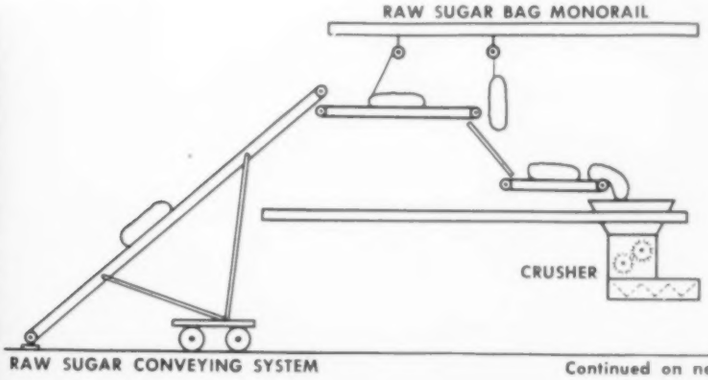
Raw sugar is fed to minglers and affination centrifugals. The washed sugar is dissolved in the melter at low temperature and high Brix. The solution is treated with calcium phosphate as coagulant, hydrated lime as precipitant and Sucroblanc as sterilizing agent and decolorizer. A proper combination of these reagents precipitates most of the colloidal organic impurities and coloring matter, which are flocculated by the application of heat in a continuous flotation clarifier. All the added reagents are eliminated with the impurities. Floc is floated to the surface and clarified liquor is ready for final decolorization.

Clarified liquor is treated with decolorizer, filter aid and dechlorinator and pumped through a battery of rotary pressure filters. The resulting filtrate is a sparkling white liquor of exceptional clarity and purity. It is concentrated to 70 deg. Brix in the triple-effect and sent to the vacuum pan for crystallization.

The standard vacuum pan system of crystallization produces in conjunction with centrifugals several strikes of wet white sugar. These strikes are mixed together and passed over successive heating and cooling drums of a rotary horizontal granulator. The sugar is sifted through magnetic vibrating sifters, in which it is classified according to grain size. The finished dry granulated sugars are packed and sent to the warehouse or into delivery trucks. The main steps in the Sucrest refining process are illustrated by the accompanying diagrams and pictures.

Raw sugar comes from different countries in various sizes of burlap bags. These bags are conveyed to the raw sugar elevator by mechanical means into which the bags are opened and emptied

All raw sugars are paid for on the basis of their content of pure sugar. Careful sampling is therefore very important and samples are taken by the customs inspectors as well as by the buyers representatives while the bags pass over the weighing scales in the pier



RAW SUGAR CONVEYING SYSTEM

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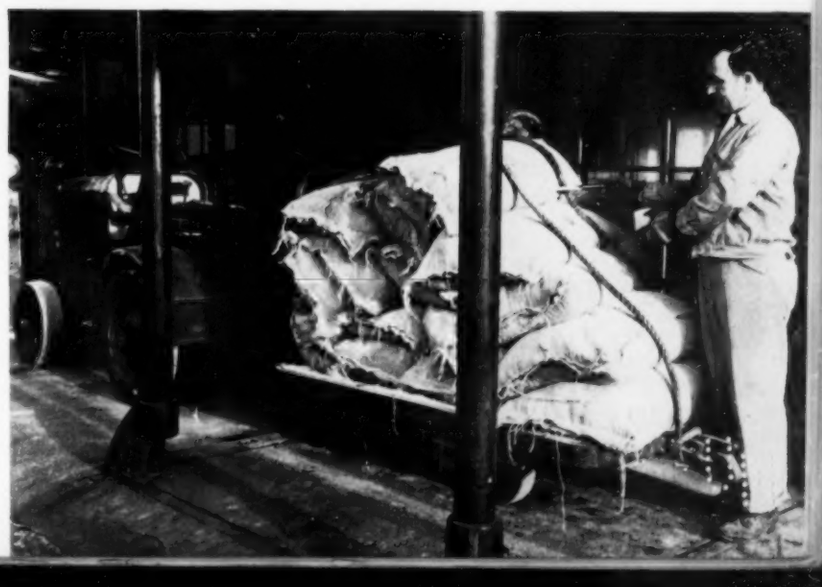
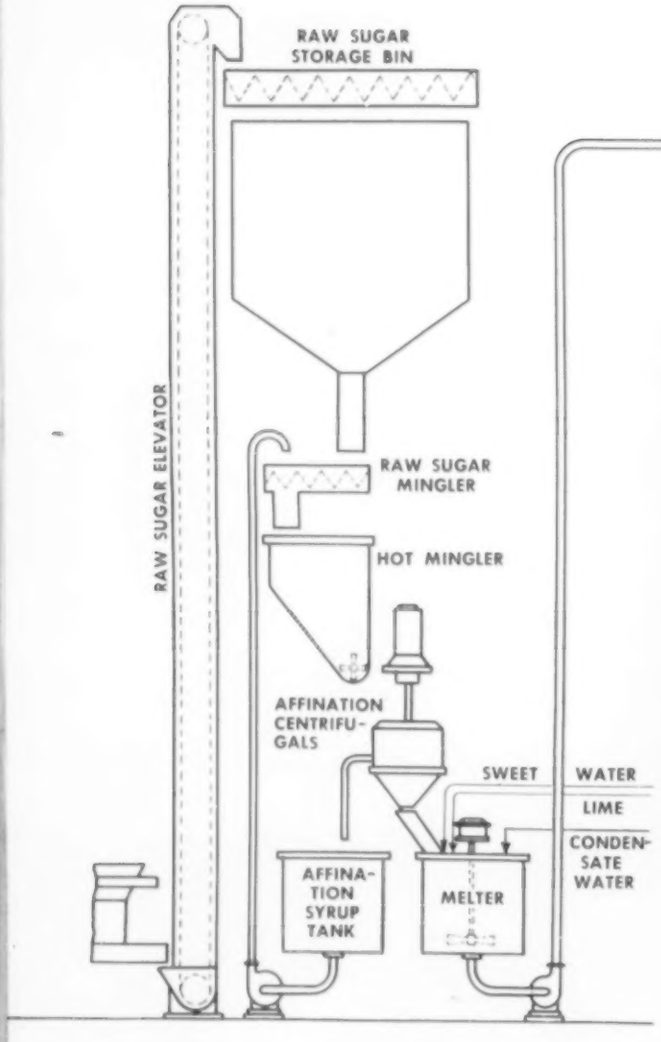
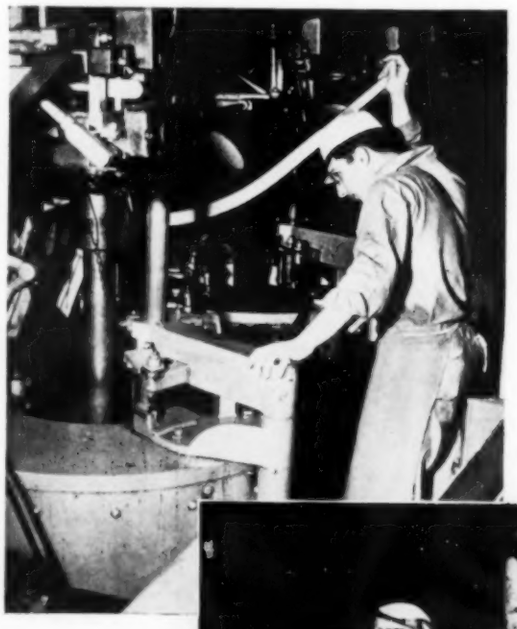


Raw sugar is stored in bins for a day's run. Notice the operator near the top handling the conveying system

In the mingler the raw sugar in dry form is impregnated with affination syrup to loosen the film of molasses adhering to the raw sugar crystals

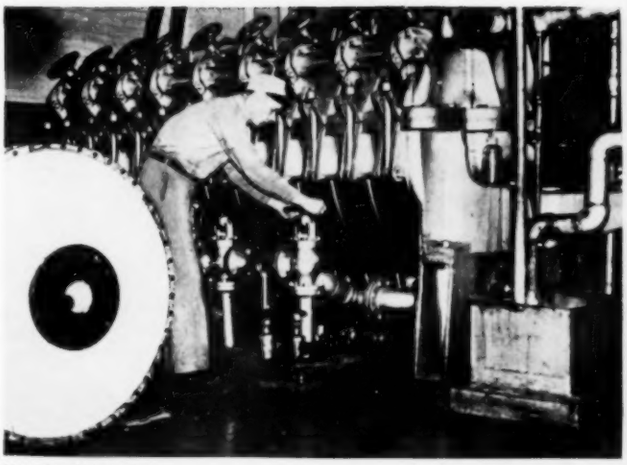


Charging one of the high speed affination centrifugal machines. Only two of these machines supply all washed sugar necessary to produce over 400 tons of refined sugar a day

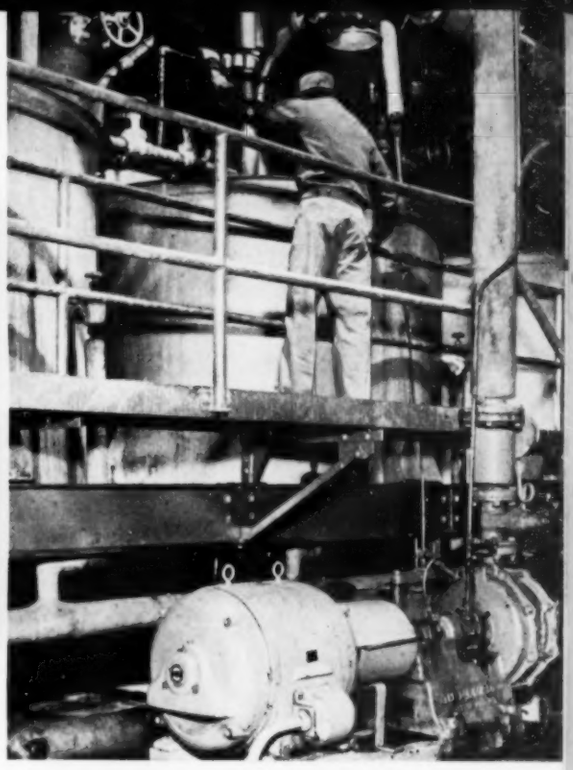


The clarifying and decolorizing agents are dissolved first in small agitated kettles before being proportionally added to the liquors to be purified and decolorized

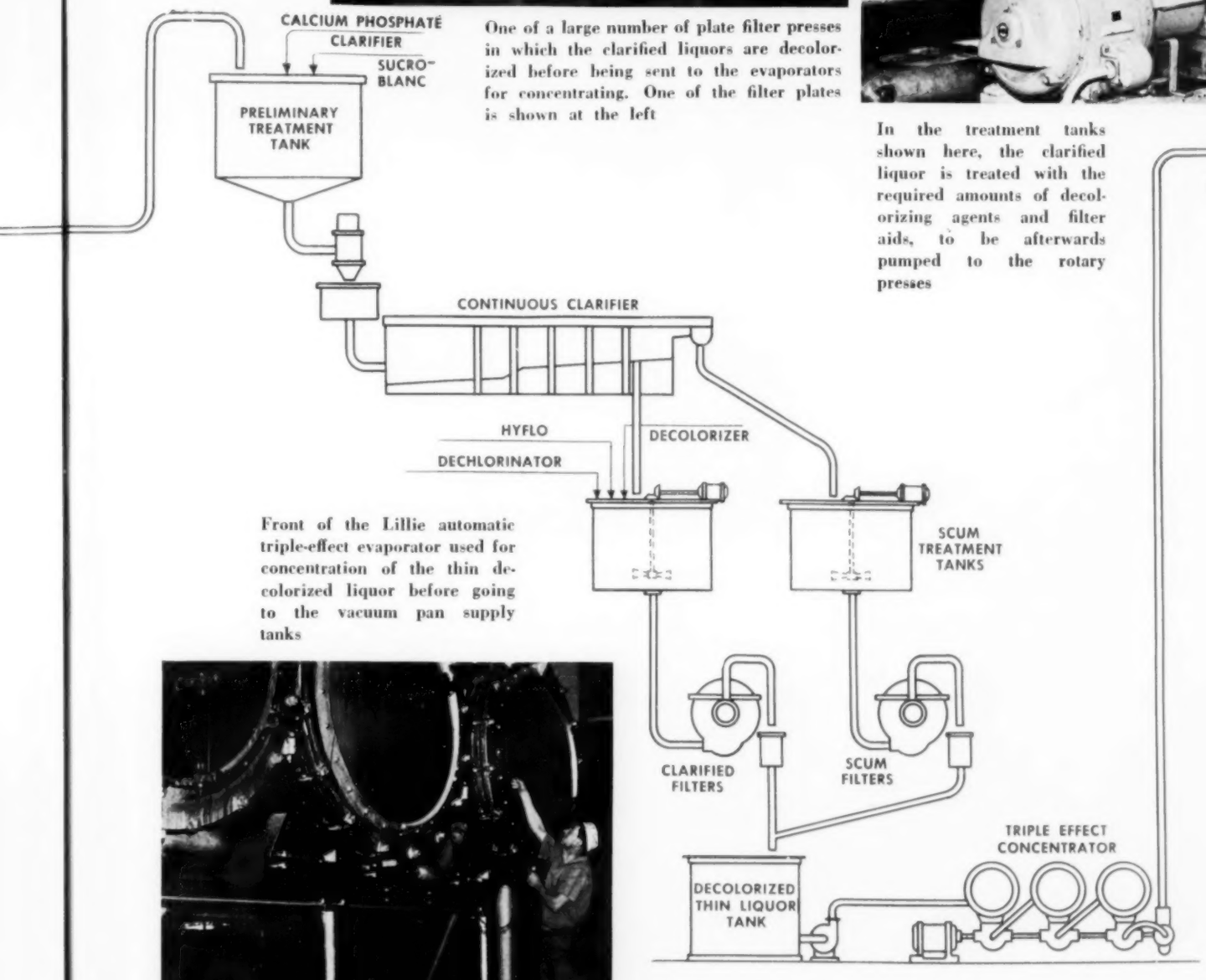
A Chem & Met PICTURED FLOW SHEET



One of a large number of plate filter presses in which the clarified liquors are decolorized before being sent to the evaporators for concentrating. One of the filter plates is shown at the left



In the treatment tanks shown here, the clarified liquor is treated with the required amounts of decolorizing agents and filter aids, to be afterwards pumped to the rotary presses



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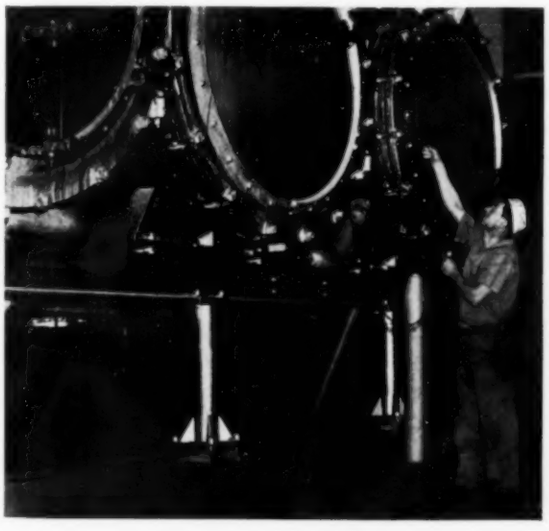
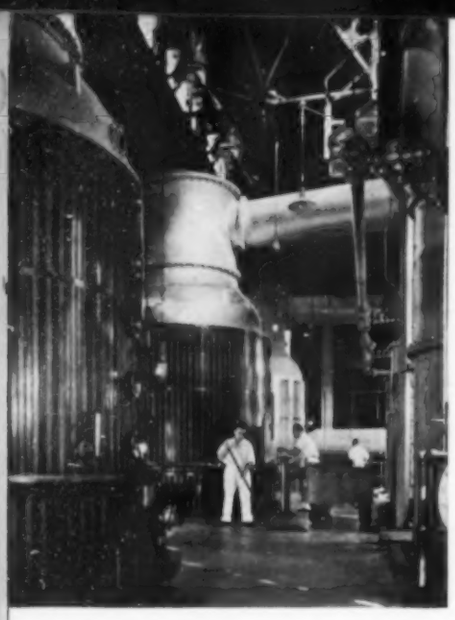
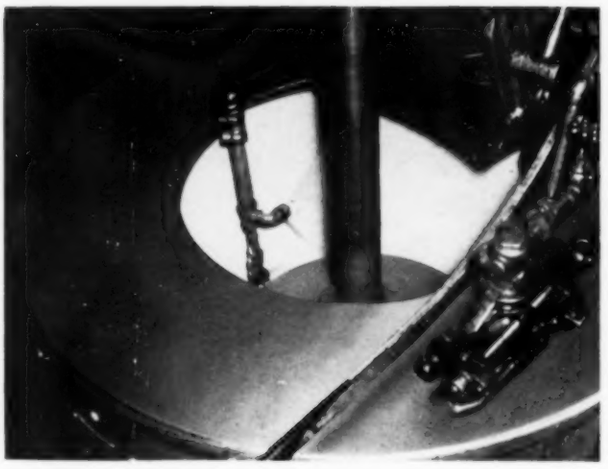
Front of the Lillie automatic triple-effect evaporator used for concentration of the thin decolorized liquor before going to the vacuum pan supply tanks

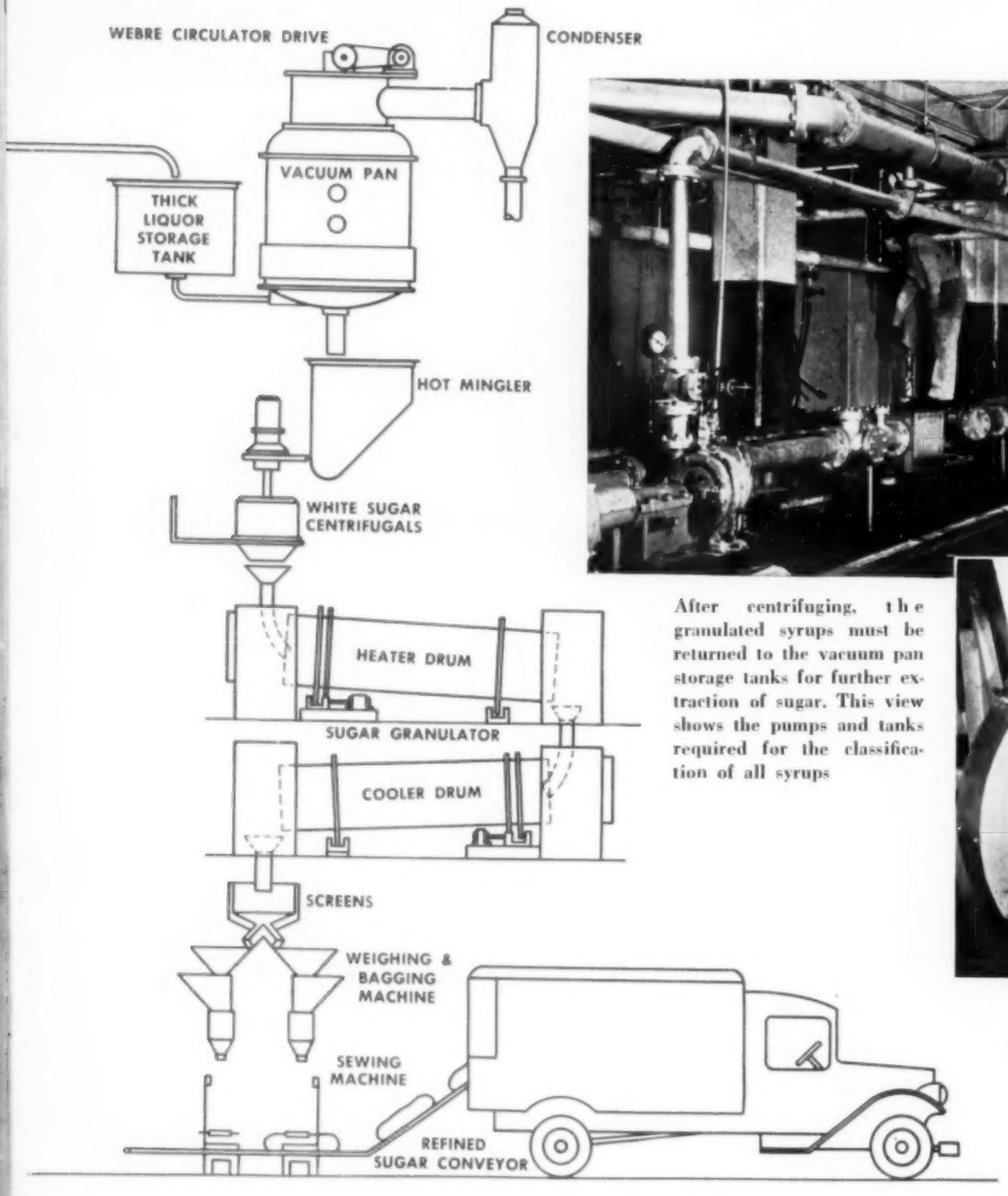


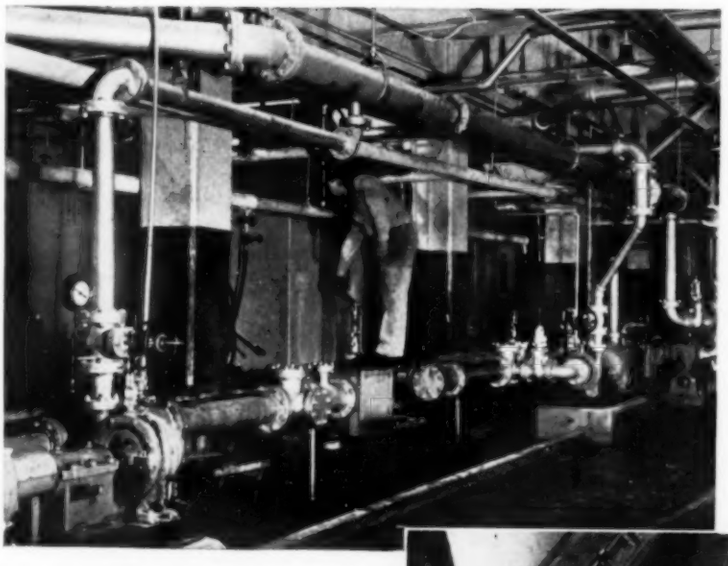


A view of the vacuum pan floor in which the vacuum pans are seen at the left and the condensing equipment at the right. Here the decolorized liquor is crystallized into the proper grain sizes. The mixture of crystals and the mother liquor called massecuite is discharged into the mixers to feed the centrifugal machines



A white sugar centrifugal machine in which an automatic spraying machine washes the white sugar after the mother syrup has been forced out by centrifugal force





After centrifuging, the granulated syrups must be returned to the vacuum pan storage tanks for further extraction of sugar. This view shows the pumps and tanks required for the classification of all syrups

Conveyors carry the sugar from the dryers to the screening machine

Chemical Engineering NEWS

TAPPI Meeting Will Discuss Changes in Constitution

The program for the annual meeting of TAPPI to be held at the Roosevelt Hotel, New York, Feb. 19-22, calls for a general session on the morning of Feb. 19 with F. C. Clark presiding. R. G. Macdonald will submit the secretary's report and various committees also will report. One of the important matters to come before the meeting is a discussion of the constitution and by-laws which has been proposed to replace the present articles of organization. Copies of the proposed constitution and by-laws have been mailed to members and the proposals will be voted on at the annual meeting and later by mail ballot. Election of officers and members of the executive committee will be announced in accordance with the results shown by the mail ballot which has been conducted. Following the business session, papers will be read by R. A. Hayward, G. D. Bearce, and C. W. Rivise.

The annual luncheon will be held on Feb. 22 with F. C. Clark as chairman. Ernst Mahler will present the TAPPI Medal to Otto Kress and Harry Fletcher will speak on the twenty-fifth anniversary observance. D. C. Everest also will deliver an address.

Technical sessions, as usual, will take up the greater part of the four-day meeting. On the afternoon of Feb. 19 there will be sessions on water under the direction of L. B. Miller; on acid pulping and heat and power with H. A. DuBois and Pell Foster as chairmen; and on paper testing under the direction of B. W. Scribner. Morning sessions on Feb. 20 will include: coating with F. W. Egan in charge, alkaline pulping, Paul Hodges chairman, nonfibrous materials, preparation and testing, conducted by W. A. Kirkpatrick and C. M. Connor. Scheduled for the afternoon are alkaline pulping and pulp purification, Paul Hodges and Charles Carpenter chairmen, microbiology session, Allen Abrams, chairman. On the morning of Feb. 21, J. F. Halladay and F. W. Egan will present a session on graphic arts, J. A. Lee and W. G. MacNaughton will handle a meeting devoted to materials of construction and in the afternoon, there will be sessions on containers with A. W. Nickerson presiding, on heat and power with A. E. Montgomery, Grover Keeth, and L. G. Green chairmen, and on optical properties with J. L. Parsons conducting. On Feb. 22, A. E. Bachmann and G. Lamont Bidwell, Jr. will direct a meeting on forming and finishing and C. E. Curran will have charge of a session on coating and new products. The Inter-Society Color Council also will discuss color problems in the morning and hold a business meeting in the afternoon.

A.C.S. Will Hold Ninety-Ninth Meeting in Cincinnati

More than 3,500 chemists will convene in Cincinnati April 8 to 12 for the ninety-ninth meeting of the American Chemical Society. Sessions will be held by seventeen of the Society's professional divisions.

Hundreds of papers and addresses reporting advances in pure and applied science in the research laboratories of the nation's industries, universities, technical schools, and state and federal services, are scheduled. Practically every major field of chemistry and its allied sciences will be explored.

Dr. Alfred Springer, of Cincinnati, who on February 12 celebrated his eighty-sixth birthday, has been appointed honorary chairman of the meeting, which will be held under the auspices of the Cincinnati Section of the Society. Procter Thomson, head of the Standards Department of the Chemical Division of the Procter and Gamble Co., will be general chairman.

Ten symposia scheduled for the meeting embrace the utilization of agricultural wastes, the combustion of solid fuels, the chemistry of insulation, cellulose plastics, sulfanilamide and related derivatives, sterols and lipoids, the application of mathematics to chemistry, fundamental chemical thermodynamics of hydrocarbons and their derivatives, phase transitions, and the future of chemistry as a specialized science in the high school curriculum.

Bloede Scholarship Open for Coming School Year

Announcement is made by the Board of Trustees of The Chemists' Club that applications will be received for the Bloede Scholarship for the school year 1940–41. This scholarship, which was founded in 1916 through the generosity of the late Dr. Victor G. Bloede, was originally awarded annually. Appointments are now to be made in alternate years; the stipend is $580, paid in semi-annual installments of $290.

Candidates are limited to men entering the last year of post-graduate work leading to the Ph.D. degree in chemistry or in chemical engineering in an institution of recognized standing. It is understood that the applicant should not hold simultaneously any other remunerative appointment. Blanks may be obtained from The Secretary, The Chemists' Club, New York. Applications will not be accepted after April 15, 1940. The scholarship committee of the Club consists of M. T. Bogert, S. D. Kirkpatrick, J. R. Withrow, D. D. Jackson, vice-chairman, and L. W. Bass, chairman.

Standard Oil Secures Rights To Make Buna Rubber

The Standard Oil Co., of New Jersey has announced that it controls the buna rubber development in this country and will produce it for domestic markets at an early date. Rights for production were acquired from the I. G. Farbenindustrie of Germany where this synthetic product has been produced for some time. In the early stages of buna development the German company recognized that petroleum rather than coal would be the cheapest raw material for making butadiene in countries where there is a supply of oil at low cost. While buna was in the experimental stage it was brought before the Standard Oil Co. and its technical cooperation was enlisted.

The synthetic rubber made from butadiene and acrylic nitrile is known as "Buna-N" or "Perbunan." It has most of the desirable rubber-like properties of natural rubber and in some of its properties, such as resistance to heat, to abrasion, to aging, and to swelling in gasoline and oil, it is superior to natural rubber. The product made from butadiene and styrene is known as "Buna-S."

The first domestic production will be confined to the perbunan type and the Standard Oil Co. has offered to license rubber companies to produce the material for their own requirements.

Research Program Sponsored For Bonechar

Announcement has been made of the inauguration, at the National Bureau of Standards in Washington, of a research project on bonechar to investigate the chemical and physical reactions inherent in bonechar adsorptivity.

This project is under the direction of Frederick Bates, Chief of the Polarimetry Section of the National Bureau of Standards. Mr. Bates is the president of the International Commission for Uniform Methods of Sugar Analysis. Dr. V. R. Deitz, formerly of Johns Hopkins University, has been engaged for the active prosecution of the work.

NEWS FROM WASHINGTON

Washington News Bureau
McGraw-Hill Publishing Co.
Paul Wooton, Chief

TAX PAYERS also vote. Hence, economy in federal spending has become newly important to Congress. Not all of the brave gestures of January will become savings in final appropriation bills. But Congress has apparently decided that it is better to spend less during the next year than it is to pass either tax-increase or increased-federal-debt-limit legislation before the next election.

Labor Laws

Seldom have Congressional investigations uncovered more unsavory administration of law than in the N.L.R.B. special investigation committee of the House. Chairman Smith and principal investigator Toland have used the Board records and personnel to determine the extremes to which administrative bodies can go when they are disposed to utilize to the full carelessly drawn laws and even extra-legal procedures. Two results are expected.

(1) Congress is impressed that there should be some judicial review of administrative actions of this sort. This greatly advances the cause of those who wish to establish an Administrative Court to serve as a review tribunal passing on the quasi-judicial findings of various executive departments and independent agencies that now report only to the President.

(2) Some revision of N.L.R.B. is inevitable. The Administration hopes that a changed personnel willing to drive near the middle of the road, instead of English-wise at the left curb, may be enough to appease the critics. The critics say "abolish the Board" and start with a fresh attempt on control of labor relations. The Administration plan appears much more likely to prevail.

Wage-Hour Division changes are being made by the new administrator, Fleming. Here again Congress is likely to let internal re-adjustment accomplish most of the needed corrections before passing any drastic or restrictive changes of the law.

Mines Bureau Purge

The forced resignation of Dr. John W. Finch as director of the Bureau of Mines is to be followed by further Administrative changes. Basically the issue is regarding the fundamental purpose of the Bureau. Career members of the staff are almost unanimous in their desire to retain the Bureau as a fact finding and research agency. They oppose inter-mingling of regulatory or police functions. Whenever those functions are wanted, these conservatives say, they should be established elsewhere, not within the technical Bureau. Secretary Ickes thinks otherwise.

With the naming of a new director, the controversy will not be settled. The issue reaches to the very inmost circle of Administration planning. One of the measures Secretary Ickes wishes is fostered by CIO chief, Lewis. And Mr. Lewis is not welcome in White House circles just now. The Bureau is being used by all parties as the ball in a free-for-all rugby game. The rule book has been thrown away, and the more shins and heads cracked the better the participants enjoy it.

News "Fines"

No Phosphate Report—Congress got a perfunctory report on January 15 regarding the phosphate, potash, and manganese special committee inquiry. But the committee asks another year in which to spend the last $5000. Apparently the special session of Congress which dealt with the Neutrality Law prevented the desired travel of the committee members through the West. They will probably have their trip next Summer, and perhaps report next year.

Too much arsenic—Regular use of large quantities of arsenical insecticides is causing serious concern among land use specialists of Washington. When an old apple orchard is cut out, there is difficulty in farming the land with normal rotation of crops as the residual arsenic apparently prevents growing alfalfa and other legumes. Even in the cotton areas of the South there is enough arsenic accumulating in the soil to make necessary special crop rotation plans. All this encourages the search for an organic insecticide as a substitute. Agronomists object to indefinitely continued arsenic use when it prevents soil rebuilding by leguminous crops. They are very influential.

Wood Coke Patents—Washington has reviewed with interest patents granted to a Mr. Ruzicka during Christmas week because Bonneville Authority is being urged to base wanted steel plant developments on this patented fuel and novel blast furnace procedure. Technical advisers are skeptical. But a political rather than technical decision would not be surprising.

TVA Taxes—Congress must find some way to reimburse Tennessee and other states for the large tax loss suffered as TVA takes over great utility systems. This may warp the "yardstick" plans a bit. TVA is nothing like as well thought of in Congress now as hitherto. It barely escaped having all new activity and half of its old funds cut off in a bitter House battle during January.

Two Research Surveys—The special survey of industrial research being made by National Research Council for National Resources Planning Board is to be supplemented by another parallel effort. An advisory committee has been named by the Department of Commerce to assist it in planning this new business-research study. It will deal with production economics, marketing, finance, and social questions of personnel and industrial relations. Important executives of chemical process industry and closely related business dominate the advisory committee. The report resulting will be, however, essentially a program for the Planners. It will be published later as Part 3 of "Research, a National Resource." The summary of the scientific and engineering research survey will become Part 2 of that document.

Consumer Standards—The Boren bill, which proposes to establish a special consumers' standards unit in the National Bureau of Standards, is getting much attention as a result of Congressional hearings in January. It looks as though this very conservative bill might actually pass. In effect it would enlarge the funds, but not substantially change the Bureau of Standards' authority, for setting up fair standards for commercial goods which could be used voluntarily by industry. The only penality provided is that Federal Trade Commission action could be taken if someone claimed the goods met consumers' standards when they did not.

Stop Exports, Or Else—The military authorities of the government are warning profit-seeking speculators in trategic materials that if they do not voluntarily refrain from selling crude rubber, pig tin, and other such materials for re-export, "other means to deal with the situation" will be taken. It will not be surprising if Congress does set up some such export license plan. Many think that Congress is also going to pass a law restriciting exports of scrap metal and other raw materials to Japan and Russia.

Walsh-Healy Wages—The Department of Labor is expected to announce during February a plan for hearings to determine minimum wages in the chemical industry. This procedure will be under the Walsh-Healy law. The results, when determined, will govern the minimum wages which may be paid by companies seeking to sell chemicals to the government under conditions that place the contracts within that law. This procedure is quite independent of the minimum wage proceedings of the Wage-Hour Division of Labor.

New Alcohol Ruling—Difficulties with diversion of rubbing alcohol to beverage uses have occasioned a new ruling for labels and sales of rubbing alcohol compound. The sales of such compound containing authorized specially denatured alcohol is now strictly limited to the wholesale and retail drug trade and to such institutions as hospitals, turkish baths, athletic associations, etc., as are presumed to require it in their business.

WAR-TIME DECREES INCREASE GOVERNMENT CONTROL OF GERMAN CHEMICAL INDUSTRY

Special Correspondence

ALTHOUGH production figures for the German chemical industry since the beginning of the war are not available, it may be assumed that the 1939 output was considerably higher than in 1938 when it was valued at 6,000 million RM, as against 5,000 million RM in 1937 (excluding staple fiber and synthetic rubber, but including mineral oil refining). More recent figures would include the additional production of Austria, the Sudetenland, the Bohemian-Moravian Protectorate, and German-occupied sections of Poland, and therefore make comparison difficult. War-time decrees have increased government control and raw material shortages have not made plant operations any easier, although the transition from peace to wartime was easier for the chemical than for most other industries since the former was already virtually geared to wartime operations.

As the focal point of the "Four Year Plan" introduced in September 1936, the chemical industry (including plants producing mineral oils, rubber and synthetic rubber) now employs about 650,000 persons, with an annual payroll in excess of 1,500 million RM. The average week for workers in the chemical industry for the first six months of 1939 was 47.2 hours as against 42.4 in 1932 and 46.5 in 1938. Since the war, as in all branches of industry, the working day in the chemical industry was lengthened and then shortened again. The chemical industry's difficulty in obtaining a sufficient number of skilled workers is still reflected in the pages of display and classified advertisements.

Indispensable specialists have not been drafted for military service, and wherever possible, women have taken the place of men. In fact, according to official figures, at the beginning of December there were only 126,000 unemployed in the "old" Reich, and most of these were unemployables. Although the obvious explanation for the small amount of unemployment is that many men are under arms, this figure is interesting because in the world war several millions became unemployed shortly after the war began and production in many consumption goods industries had been curtailed as at present.

The effects of the war on the earnings of the chemical industry are difficult to ascertain. On the bourse, I. G. Farben stocks are now noted at 168, which is above its 1939 high. I. G's most recent dividend was 8 per cent, as against the usual 7 per cent of the past five years. On the other hand, Ruhrchemie A. G., a smaller concern, passed over its dividend completely in December and reported an operating loss for its subsidiary Ruhrbenzin A. G. The MAN (Maschinenfabrik Augsburg-Nurnberg), whose production last year was double that of 1934, increased its capital stock recently from 20 to 30 million RM. A.E.G. (General Electric) reported on Jan. 1 an increased turnover for the year 1938–9 reaching 602 million RM as contrasted with 487 million RM the previous year. From Jan. 8 to 20, Braunkohle Benzin A. G. (Brabag), which operates extensive synthetic gasoline plants and lignite mines in central Germany, issued 40 million RM of 5 per cent bonds in order to extend its activities, while I. G. Farben issued 100 million RM of 4½ per cent obligations in the summer of 1939. In December, German industry experienced further concentration in the merging of the Salzdetfurth A. G., potash concern, and the Mansfeld A. G. fuer Bergbau- und Huettenbetrieb. This brings considerable potash, coal, and copper production under unified management, and further illustrates the tendency in German industry to extend production. I. G. Farben, which controled about 40 per cent of German chemical output last year, is the classical example of this trend.

The availability of Swedish ores, barring actual military occupation of Sweden by foreign powers, should continue, as long as Germany has control of the Baltic. In this connection it is of interest that the old Hanseatic cities on the Baltic as Luebeck, Stettin, Danzig and Königsberg have increased in importance as transhipping points, while Hamburg and Bremen on the North Sea have declined in relative importance since overseas shipping is virtually blockaded. The Kiel canal, however, is making possible shipments from Baltic to North Sea ports.

Before 1914 the freight traffic between Germany and Russia went primarily over the Baltic harbors. Much of present German-Russian trade is following the same routes. This is necessitated by the fact that direct rail traffic between Russia and Germany has been handicapped by the destruction of the bridge over the Bug river near Brest-Litovsk and the fact that freight from Russian wide gage rail trains must be reloaded to fit the standard gage of German and Polish rails. At present, rail traffic to Russia goes by way of East Prussia, Lithuania and Latvia. During December and January an unusually large number of freight cars carrying timber, ores, soybeans, and miscellaneous freight were noted moving westward across the Trans-Siberian railway. Although most of this is staying in Russia due to the Finnish war, considerable freight is finding its way to the Reich, and negotiations are being carried on to lower rates to Germany on the Trans-Siberian route.

Increased Russian shipments of raw materials to the Reich have already commenced, and although it is still too early to predict whether this trade between the two countries will increase sufficiently to alleviate Germany's vulnerability in raw materials, it is noteworthy that German engineers are already taking definite steps to help Russia develop its resources and transport systems. In fact, the writer has learned from an unimpeachable source, that as early as February of last year the initiative for the Russo-German trade pact came from Joseph Stalin, whose program of industrial development was bogging down and exceeding the technical knowledge and experience of the population.

From the standpoint of war machinery, coal and iron supplies for the time being will probably be adequate. Compared with the last war, synthetics production is on a considerably higher plane. Synthetic motor fuel output totaled 1.7 million tons in 1938 and was still higher in 1939. The need for oil imports remains, however. Of interest is an army report that in the whole Polish campaign, less than one month's motor fuel production was consumed by army motorized equipment.

The first synthetic rubber plant in Germany reached its full production capacity about the middle of 1939, three years after commencing construction; in 1940 its output is expected to be twice that of 1939. Construction has begun on a second large synthetic rubber plant. Its process is to be simplified so that instead of starting with coal and lime, as in the first plant, it will start directly with acetylene produced from carburetted hydrogen yielded as a byproduct from benzine plants. A completely synthetic acid and fireproof fiber is also being produced from acetylene. Production of fats from coal, by way of parraffin resulting as a byproduct of coal distillation, for soap making has reached 35,000 tons yearly, according to the Deutsche Fettsauerewerke G.m. b.H., which recently raised its capital from 600,000 RM to 7 million RM. Although it is claimed that these soap fats are of excellent quality, the poor soap available in Germany, plus the shortage of fats and substitute coffee, is one of the chief grievances of civilians. A good harvest has insured plenty of flour and fruits, but the inconvenience of standing for hours to buy rationed foods and the distribution of textiles on a "point" system illustrate the restrictions of a war time economy.

These restrictions have increased the work of the German chemical industry. What can be accomplished in this field will be demonstrated when the 1940 Congress of German Chemists will meet in Breslau, August 4 to 10, in conjunction with the annual meeting of the German Society for Chemical Apparatus (Dechema) and other related organizations. This meeting and exposition, to have been held in Salzburg last September but postponed because of the outbreak of the war, will be staged under the heading "Raw Materials and Chemistry."

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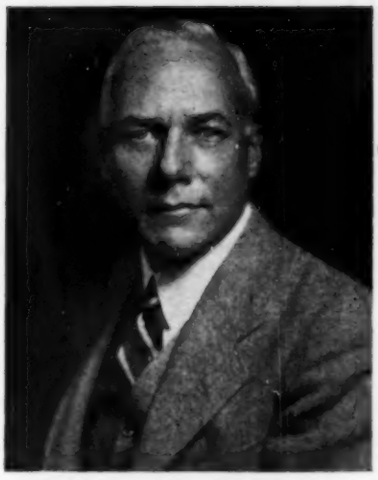

Albert B. Newman

✦ ALBERT B. NEWMAN has been made dean of engineering at the College of the City of New York. He was formerly head of the chemical engineering department.

✦ C. H. KUNSMAN, long active in research work in the Department of Agriculture, has been appointed chief of the Physiochemical and Analytical Division of the Department's Western Regional Research Laboratory at Albany, Calif.

✦ R. W. SHAFER of the Dorr Co., New York, N. Y., left January 18 for a trip to Puerto Rico. He returned about February 5.

✦ EDWARD R. WEIDLEIN, director of Mellon Institute, is to receive the Pittsburgh Award for his distinguished service to applied chemistry, and to the chemical profession, especially in that district.

✦ A. J. BROCCINI has been appointed manager of the Pacific Coast Division of E. B. Badger & Sons Co. He is a graduate of the University of Michigan and has served as a chemical engineer with Industrial Rayon Corp., Sun Oil Co. and Ebeleanu Company, Ltd.

✦ G. J. KEADY has been elected executive vice-president of the Sharples Corp., Philadelphia. He assumed his new duties January 17.

✦ ROY W. EMERSON has been appointed metallurgist and special welding engineer by the Pittsburgh Piping & Equipment Co. After graduating from the chemical engineering department of the University of Michigan, Mr. Emerson joined the research laboratory of the Carnegie Illinois Steel Co., at South Chicago and later transferred his activities to the Westinghouse Electric & Mfg. Co.

✦ RALPH LAYMAN, JR., has joined the fabricating division of William Brand & Co. at Willimantic, Conn., as chief chemist. For several years he was with the American Cyanamid Corp.

✦ JOSEPH KAYE WOOD has returned to active duty as chief engineer of the General Spring Corp., New York, N. Y. after having been temporarily connected with the Grinnell Co., Providence, R. I. and the Babcock & Wilcox Co., London, England for a total period of three years.

✦ EARL F. CLARK has been appointed manager of the heavy chemical department of the Cowles Detergent Co., with headquarters in Cleveland. He succeeds Ralph C. Hughes who resigned to accept a position with the Hooker Electrochemical Co., Niagara Falls.

✦ HARRY MCCORMACK, director of chemical engineering at Armour Institute of Technology, was recently elected president of the Illinois Engineering Council.

✦ C. H. MCCOLLAM, who until recently was chief chemist of the Timken Roller Bearing Co., Steel and Tube Division, Canton, Ohio, has been made assistant director of steel sales.

✦ C. P. GULICK, chairman of the board of National Oil Products Co., Harrison, N. J., has been appointed vice-chairman of the Industrial Practices Committee of the National Association of Manufacturers.

✦ W. A. MILLER has been appointed general superintendent of the Sherwin-Williams Co. plant in Chicago.

G. J. Keady

✦ FRED H. LANG, superintendent of the lacquer plant of Sherwin-Williams Co., Chicago, is now in charge of both plant operations and laboratory.

✦ W. S. STEVENS has been appointed to the position of manager of the pigment products division of the Sherwin-Williams Co. This department embraces the manufacture of zinc and lead pigments at both Chicago and Coffeyville.

✦ HAROLD W. SCHULTZ of the department of physiology of Ohio State University has joined the staff of Arthur D. Little, Inc., Cambridge, Mass., to carry on biochemical studies in the field of nutritional and pharmaceutical research and development.

✦ J. J. WILLAMAN has been named as chief of the biochemical division of the Eastern Regional Research Laboratory of the Department of Agriculture at Wyndmoor, Pa. He will direct the research on new methods for utilization of vegetable, apple, tobacco and other material under investigation at this laboratory.

✦ ORIEN SIMMONS, chemical engineering graduate of the University of Michigan, 1935, has accepted the position left vacant by the death of Dr. Edwin W. Mann on the chemical engineering staff at Rose Polytechnic Institute. Mr. Simmons has recently been in the employment of the Packard Motor Car Co.

CALENDAR

FEB. 19-22, 1940, TECHNICAL ASSOCIATION OF THE PULP & PAPER INDUSTRY, annual meeting, Hotel Roosevelt, New York, N. Y.

APRIL, 8-12, 1940, AMERICAN CHEMICAL SOCIETY, annual meeting, Cincinnati, Ohio.

APRIL 24-27, 1940, ELECTROCHEMICAL SOCIETY, annual meeting, Galen Hall, Wernersville, Pa.

MAY 13-15, 1940, AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, Buffalo.

MAY 27-31, 1940, AMERICAN PETROLEUM INSTITUTE, mid-year meeting, Fort Worth, Tex.

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✦C. T. BROWN has been elected vice-president of Federal Chemical Co. in charge of sales and purchases. He succeeds Arthur S. Key in this position.

✦GEORGE J. CALLISTER has resigned his position as vice president and secretary of American Potash Institute. He will return to Canada where he plans to take up residence and assume civilian service to the government in its military work.

L. R. Westbrook

✦L. R. WESTBROOK, formerly assistant director of the Cleveland Experimental Laboratory of Grasselli Chemicals Department, E. I. du Pont de Nemours & Co., has been appointed research manager of the Company's Electroplating Division. He will continue to reside in Cleveland.

✦D. W. WILSON, chemical engineer, who has specialized in fuel technology for the past ten years with M. W. Kellogg Co., has opened a consulting office at 570 Lexington Ave. New York, N. Y. He was formerly assistant professor of chemical engineering at M. I. T.

✦RICHARD L. DAVIES has been appointed manager of the newly established Market Research Department of Pennsylvania Salt Mfg. Co.

✦HARRY FREUND, chemical engineering senior at the College of the City of New York, has been awarded first prize of $1,000 in the recent contest of the New York Cocoa Exchange, Inc., for a thesis entitled "Production of Plastics from Cocoa Shells."

✦JOSEPH E. MAYER, formerly of Johns Hopkins University, who recently joined the Department of Chemistry at Columbia University, is serving as assistant editor of the *Journal of Chemical Physics*.

✦W. H. SWANSON has been elected president of the Technical Association of the Pulp and Paper Industry. Mr. Swanson has served the Association as vice-president for the past year. He is staff superintendent of sulphite, Kimberly-Clark Corp., Kimberly, Wis.

✦R. A. HAYWARD, president of the Kalamazoo Vegetable Parchment Co., Kalamazoo, Mich., has been elected vice-president of TAPPI.

✦R. G. MACDONALD has been reelected secretary and treasurer of TAPPI.

✦OTTO KRESS, technical director of the Institute of Paper Chemistry, Appleton, Wis., received the TAPPI medal, which is presented from time to time by the executive committee of the Technical Association of the Pulp and Paper Industry. The award is made for distinguished service to the industry. The presentation was made at the annual luncheon held on February 22.

✦D. R. MERRILL, formerly manager of research for Union Oil Co., Wilmington, Calif., has accepted a position with Rohm & Haas, Bristol, Pa.

✦JOHN H. BARTON has resigned the position of president of the National Oil Products Co., Harrison, N. J. Mr. Barton started with NOPCO 20 years ago as a salesman. Before his election to the presidency in June, 1938, he held numerous other executive posts.

✦C. H. DESCH retired from the post of superintendent of the Department of Metallurgy and Metallurgical Chemistry, National Physical Laboratory, Teddington, Middlesex, England, on December 31. Dr. Desch will be succeeded by Mr. C. Sykes of the Metropolitan Vickers Research Laboratories.

W. T. Read

✦WILLIAM T. READ, dean of the Department of Chemistry at Rutgers University, was elected president of the Chemist Advisory Council, New York, N. Y., at the recent annual meeting. Dr. Gustavus J. Esselen, consulting chemical engineer of Boston, Mass., was elected to the position of vice-president. M. R. Bhagwat was chosen again to fill the position of secretary. And Robert T. Baldwin was reelected treasurer.

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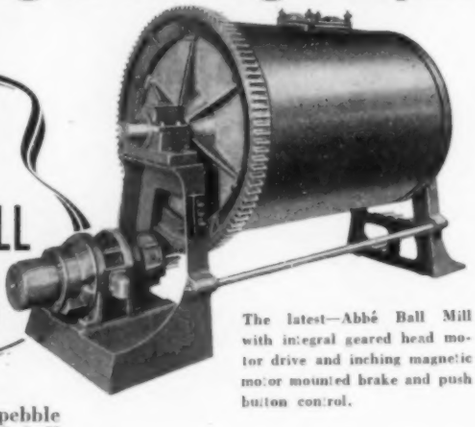

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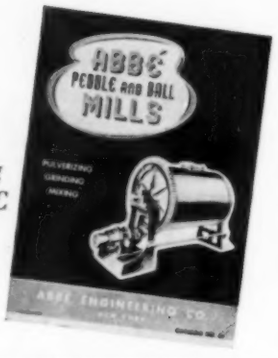

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✦ IRENEE DU PONT of the E. I. du Pont de Nemours & Co., was elected a member of the board of managers of the Franklin Institute, Philadelphia, at its annual meeting held January 17.

✦ G. G. OBERFELL of the Phillips Petroleum Corp., Bartlesville, Okla., has been appointed chairman of the American Petroleum Institute refining program committee.

✦ WEBSTER RICE of the J. T. Baker Chemical Co. has been elected president of the Chemical Club of Philadelphia. John McChesney of the Leatex Chemical Co. is the new vice-president. F. S. Dubbe of the American Cyanamid & Chemical Co. is the treasurer and G. B. Heckel, Jr., of the *Paint Industry* is secretary.

✦ JAMES K. STEWART formerly director of industrial naphtha research of the Anderson Pritchard Oil Corp., has joined the Tru-Coat Co. as director of technical service. His function will be to bridge the gap between the company's research activities and the customer problems on industrial finishes.

✦ J. M. COSGROVE has become associated with Standard Steel Spring Co., Coraopolis, Pa., as director of the Development Laboratory. Mr. Cosgrove was formerly chief chemist of Noblitt-Sparks Industries.

✦ ROY A. CARLIN is now associated with the American Industrial Co., Buffalo, N. Y., as chief chemist. He was formerly employed by the Carlin Chemical Co.

✦ W. B. LAWSON has resigned the vice-presidency of the Harshaw Chemical Co., Cleveland, Ohio. Mr. Lawson came to the Harshaw organization in 1930. He had previously been connected with the International Nickel Co. which he had served in several executive positions.

✦ GILBERT THOMAS MORGAN, until recently director of Chemical research at the government laboratories, died February 1 in a London hospital at the age of 69.

✦ FRED R. LOCKWOOD, president of the Lockwood Chemical Co., Buffalo, N. Y., died January 25. In 1929 he came to Buffalo and organized the Hamburg Chemical Co. The name was later changed to the Lockwood Chemical Co. For the last two years Mr. Lockwood has devoted all of his time to the organization of the Universal Research Corp., devoted to chemical research.

✦ MATTHEW BEARDWOOD, professor of chemistry at Ursinus College, Collegeville, Pa., died January 29. He died in a hospital at Philadelphia. His age was 68 years.

✦ SHERMAN L. DAVIS, professor of chemistry at Indiana University for many years, died in Indianapolis on February 1. He was 75 at the time of his death.

✦ HERMAN FLECK, former head of the

chemical department at the Colorado School of Mines at Golden, Colo., died January 16. He was 69 years of age. Mr. Fleck had also been connected with the chemical department of the University of Pennsylvania; for the past six years he had been a consulting engineer in Los Angeles, where he had been associated with D. C. Atkins.

Joseph Maudru

✦ JOSEPH MAUDRU, general superintendent of the Great Western Sugar Co., died Jan. 12 at his home in Denver, Colo., following a long illness. He was 50 years of age. He had been prominently identified with many technical developments in the beet sugar industry.

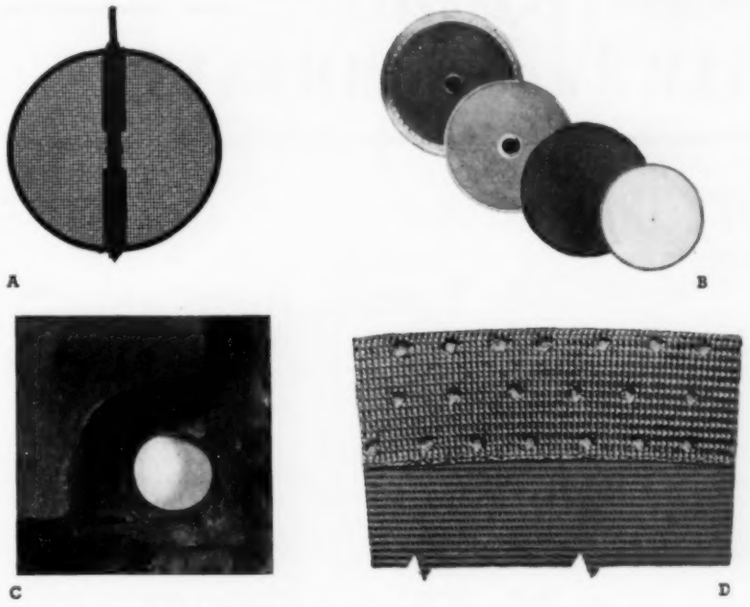
✦ PAUL HOOKER of the Hooker Electrochemical Co., died at his home at Niagara Falls, N. Y., Jan. 11, following a heart attack. He was 65 years of age.

✦ MALCOLM C. SARGENT for the past five years district sales engineer in New England for Sprout, Waldron & Co., Muncy, Pa., died Jan. 9 at the Quincy Hospital, Quincy, Mass. Mr. Sargent's death was caused by an embolism developing after operation. He had been sick for a short time.

✦ JOHN F. G. MILLER, vice-president of B. F. Sturtevant Co., Boston, died suddenly on Dec. 9 of a heart attack at his home in Brookline. He was 62 years of age.

✦ ARTHUR F. TOWNSEND, chairman of the board of Raybestos-Manhattan, Inc., and general manager of the Manhattan Rubber Mfg. Division, Passaic, N. J., died January 14, at his home in Ridgewood, N. J., at the age of 74.

✦ HENRY L. DOHERTY died December 26 at the age of 69. His contributions to engineering, machinery and methods of coal gas manufacture are widely recognized among chemical engineers. To the public he was, of course, best known as the organizer and leader of Henry L. Doherty Co. and its widespread group of utility subsidiaries held through Cities Service Co.



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B—Various Types of Hydraulic Press Pads
C—Vulcanized Rubber Gasketing for Plate and Frame Filter Cloth
D—Reinforced Cushion Type Edge on Outer Circumference of Vallez Filter Screen

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Readers' VIEWS and COMMENTS

Young Ideas on "Young Engineering"

To the Editor of Chem. & Met.:

Sir:—Your pretty editorial entitled "Young Engineering and Young Engineers" in the January 1940 issue of "Chem. & Met." was a touching portrayal—as they say in the movies—of the plight of young engineers, of the chemical industry and indeed, of the thought processes of the leaders of the industry.

You report, and correctly it seems, the fact that there are a prospective 2,500 graduate chemical engineers in schools who will be "in the market" around June. Then you point out that there are at least 1,000 jobs too few in plant operation, control and research and development for these men; that some will have to look elsewhere "in sales and marketing, personnel, public relations and advertising—in short—in any capacity in which their chemical engineering training can be used to good advantage."

You forget one important essential, it would seem to me, and that is the fact that the plight of the unemployed young graduate chemical engineer is the same plight as that of the five million young folks from 16 to 23 who are unable to be placed in industry and commerce.

It has been estimated that there are at least seven thousand chemists and chemical engineers, of which 90 per cent are under 25 years of age who are not in technical work of any kind or totally unemployed at present. That is a very low estimate.

Our colleges strain themselves, in their curricula and placement departments, to educate their students so that they may find jobs as easily as possible. My own college, a well-known institution although somewhat specialized, gave courses in industrial administration, economics, time study, mechanical engineering fundamentals, marketing, sales etc., to all its undergraduates. Net result: in the class of 1938, of which I was a member 59 per cent are still unemployed, or working entirely outside the field of engineering or going to school for further scholastic achievement and thus putting off the day of final reckoning.

Take this writer's experience, for example. It is more than typical of young engineers in chemistry today.

I graduated from college in June, 1938, and for the most part was interested in placement in production work in certain specific industries, even specific companies. Through travelling to these prospective employers for interviews I was soon disillusioned as to my chances. They told me plainly that I was wasting time, "top third or no, we're hiring experienced men only."

My previous experience, prior to entering college, had been in public relations work, sales and administrative work in large firms, in minor capacities true, but with solid and practical foundations. I was equipped by experience and education for the very thing your editorial called the turning places of our industry.

No "incipient specialist" and with many and varied interests I found no place for myself in the industry whatever. The reason? I am wont to charge the short-sighted big-wigs of our personnel offices who refuse to see beyond their present needs.

Let me cite an example of what this may mean in the future. In this city and its vicinity are concentrated much of the nation's shipbuilding activities, particularly naval ship-building. At present the government is intensely engaged in building up its naval forces and has appropriated enough money for the building of twice as many ships as are now being built. There is ample capacity in the yards for building the needed jobs, but—there aren't half enough shipfitters, marine mechanics and allied trades, including marine draftsmen. You see, ship-building suffered from an intense lull during 1929-1938 during which time many men were put out of work, none hired. The skill of former mechanics has deteriorated as they found work in other pursuits. None has been training to take their places. And so the national defense suffers.

Our industry is young, growing and can well fill its ranks with youths of vision, ambition and foresight. Their stamina will eventually be the backbone of chemical engineering. If we don't fulfill our obligation then chemical industry will suffer, as is shipping today, for lack of good men with ample experience.

I have listened to such leaders as Dr. C. M. A. Stine of duPont, Editor Williams Haynes of *"Chemical Industries"* and yourself. Together with fellow youngsters of chemical engineering I have weighed the words. The words are fine. The deeds are few.

Rather should our leading lights go into the colleges to interview the seniors, search the files for men who have, like myself, the maturity and interest to succeed but whom no one has ever given a proper chance. That will be real service to the chemical industry.

We juniors stand ready to serve the industry and the nation with our training, our ambition and our experience. We wish to serve as soldiers of industry, not in the army of the unemployed.

Without pathos I must plead—"give us our fair chance." Some of us, including myself, are willing to start as laborers in order to "get in"—many of us are equipped to work in personnel, in sales, marketing and public relations. Why hold back our future? Frustration does not breed successful chemists or engineers or anything else.

Let your conscience and common sense guide you in the proper direction.

M. H. B.
Junior Chemical Engineer
Norfolk, Virginia

OLDER IDEAS SAME SUBJECT

To the Editor of Chem. & Met.:

Sir:—In your editorial "Young Engineering and Young Engineers" you have put your finger on a problem that is important to the Universities, to the engineering students themselves, and to the professional societies. In one way, calling it a problem—that not all engineering students can find their way into the strictly engineering branches of activity—makes it seem worse than it really is. I think it is a good thing provided, of course, that men who go into the auxiliary branches of the chemical industry are equally well trained. The chemical industry is such a highly complex enterprise that it requires men with sound chemical engineering train-

ing not only on the drawing board and in carrying on the unit operations in the plant, but also in sales development, market research, general management, and perhaps even in finance.

If I am not mistaken, some of the soundness and progressiveness of the chemical industry today is due to the fact that at last men with engineering training are penetrating into senior management positions. In view of all this it would really be too bad if the profession of chemical engineering were viewed in too narrow and technical a light by the professional organizations.

THEODORE M. SWITZ
Foreign Relations Department
Hercules Powder Co.
Wilmington, Del.

"PROTECTING INEFFICIENCY"

To the Editor of Chem. & Met.:

Sir:—After reading your editorial entitled "Protecting Inefficiency" which concerns the question of Department of Interior disapproving the construction of certain natural gas pipe lines, I wonder if you have all the facts in the case.

Have you ever figured how much unemployment is involved in the replacement of bituminous coal which has already resulted from the increased use of natural gas? (I believe the coal replaced figured about sixty-one million tons in the year 1937). Have you ever calculated the amount of work lost to miners, railroad and transport workers by this replacement, and who pays for the increase in Relief Rolls on account of this? Do you believe that unemployment is one of the nation's greatest problems, and if so, do you think it should be considered in making decisions of this kind? In proportion to the cost or value of the products, what percentage of taxes are paid by mining companies and railroad companies which transport coal as compared with natural gas pipe lines and distributing companies? How do our reserves of bituminous coal compare with reserves of natural gas?

By asking these questions, I do not mean to indicate that natural gas should be prohibited by law from competing with bituminous coal. There have been, however, many efforts recently to obtain federal funds for the construction of natural gas pipe lines which would supply certain communities with relatively cheap natural gas at the same time adding a corresponding number of mining and railroad and transport workers to the Relief Rolls.

I think it is refreshing to note that one department of our government is at least stopping to look and listen before encouraging conversion of this kind when so much of our government's policy has been entirely cockeyed. We have been building hydro-electric plants with government funds; permitting the importation of foreign oil with little or no duty; and to an extent (I am not sure how much) assisting in the construction of natural gas pipe lines; all of which has resulted in a tremendous replacement of solid fuel by sources of energy which employ relatively very little labor. A dollar spent for solid fuel probably represents a larger payment to labor than a dollar spent for almost any other commodity.

If you are familiar with all the ramifications of this question I can only say that I disagree with your conclusion. If you are not, I believe that it is an important one and deserving of serious study.

DAN M. RUGG
Vice President,
Koppers Company,
Brooklyn Division,
Brooklyn, N. Y.

AVOIDING CLOGGED BIN HOPPERS

To the Editor of Chem. & Met.:

Sir:—I have read with interest the article under the above title in the January issue of *Chem. & Met.*, page 22-3, but I notice that Mr. Sandstrom has omitted the best method of all—the use of electric vibration—which has been advertised for some time in your magazine.

This method consists merely in placing an electro-magnet vibrator on the outside of the bin. The vibrator makes it impossible for the material within the hopper to stick, arch, hang up, or do anything of the sort. In other words, as stated in the advertisements, these vibrators "cure bin constipation" regardless of how severe or chronic the case may be.

Best of all, the method is simple and inexpensive. This writer understands that the method is in use in hundreds of installations and that designers are now making it a regular part of their hopper designs.

W. F. SCHAPHORST
Advertising Engineer
Newark, N. J.

HOW TO UTILIZE WASTE ENERGY

To the Editor of Chem. & Met.:

Sir:—We have an interesting problem here and perhaps some of your readers would care to offer a suggestion. It concerns the utilization of electrical energy which is now going to waste.

Every night between the hours of 7 p.m. and 7 a.m. there are 105 hp. available which could be used for manufacturing purposes. The question is what to do with it. Possibly we could install equipment to run some chemical process. In addition to the power, there is about 600 sq. ft. of floor space which could be devoted to the new venture.

We shall be very much interested in the comments anyone may wish to make.

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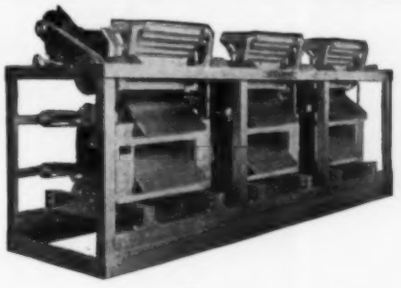

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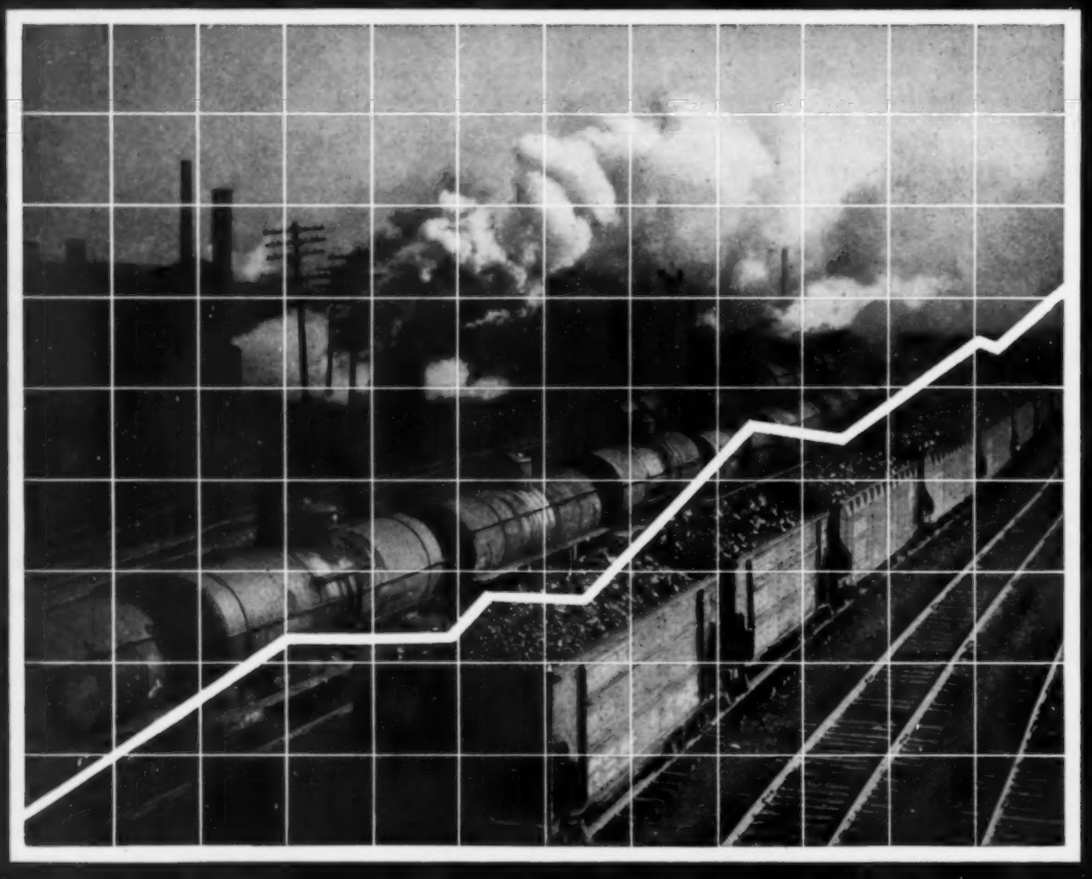

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Physical Chemistry and the Engineer

THE MATHEMATICAL THEORY OF NON-UNIFORM GASES. By *Sydney Chapman* and *T. G. Cowling*. Published by The Macmillan Co., New York, N. Y. 404 pages. Price $7.50.

Reviewed by *Frederick C. Nachod*

DRS. CHAPMAN AND COWLING are to be congratulated for their excellent book. Not only is the systematic outline of the work clear and well defined, but the mathematical derivations are arrived at with painstaking accuracy and utmost finesse. In a short introductory chapter the reader is lead through the molecular hypothesis of gases, the kinetic theory of heat, the three states of aggregation and the theory of gases. Details are given explaining why statistical mechanics are the basis for all deductions and calculations and why quantum theory and quantum laws based on classical mechanics are the basis of the phenomena of collective of individual particles. The next few sections are devoted to vector and tensor calculus, definitions and theorems, to Maxwell and Boltzmann's well known equations and the Maxwell function of velocity distribution. Expressions for non-uniform states for simple gases and mixtures of gases are derived and special examples cited. Experimental data on viscosity, thermal conductivity and diffusion show the checking of experiments against theory. Chapters on dense gases, quantum theory and transport and electromagnetic phenomena in ionized gases conclude the book.

One appendix presents in detail the integration method used by David Enskog, to whom the authors have dedicated their book. The other appendix gives the Maxwell-Boltzmann velocity distribution. Finally, the historical summary will be extremely helpful for anyone engaged in teaching the kinetic theory of gases.

Summarizing, one may say that there are two outstanding characteristics of the book, namely painstaking accuracy and mathematical elegance. To find both of them in a text on theoretical physics is as admirable as it is rare.

"THE RAMAN EFFECT AND ITS CHEMICAL APPLICATIONS" by *Joseph H. Hibbon*. Published by the Reinhold Publishing Corp., New York, N. Y., 544 pages. Price $11.

Reviewed by *W. L. Abramowitz*

THE AVERAGE CHEMICAL engineer or industrial chemist is not generally confronted with the Raman effect since its phenomena still lie chiefly in the realm of pure research. However, to use the modern terminology, the battleground of science respects no neutrals. The Raman effect is but another front at which man strives for mastery over atoms and molecules and scientific outposts have remarkable tendencies to turn into technical and industrial fortresses.

Chemical substances upon irradiation (monochromatic for the sake of simplicity) take up part of this light as vibrational energy and emit light of shifted wave lengths. The amount of this shift determines the Raman effect. Through Raman spectra, information may be had respecting atoms in their normal state, their arrangement in space, the forces between them and the amplitudes and frequencies of their vibrations. In respect to knowing quantitatively why reactions occur and when they will occur, chemistry is still more of an art than a science, our knowledge being principally empirical and based on analogy. Quantitative data on the forces between atoms are the next great step forward.

It has already been possible to deal with simple molecules on a completely theoretical basis and partially with complex molecules. Even methacrylate resins have yielded to the methods of Raman spectra. It is frequently assumed that common organic and inorganic atoms have certain definite formulae. Raman spectra have shown that classical assumptions are often incorrect.

The book is divided essentially into three parts. Part I deals with the nature of the Raman effect and its relationship to atomic and molecular vibrations; Part II applies the principles of Raman spectra to organic molecules; Part III to inorganic molecules.

The vast amount of research which has gone into the problem is indicated by the fact that Raman announced his work in 1928 and that in less than a dozen years, there are available enough experimental data to more than fill a book of 544 pages.

THE PHYSICAL EXAMINATION OF METALS. By *Bruce Chalmers*. Published by Longmans Green & Co., New York, N. Y. 181 pages. Price $4.

Reviewed by *E. Henning*

AS THE AUTHOR STATES in his preface "certain physical methods of examining metals have become such ordinary part of the metallurgist's technique that they have come to be regarded as metallurgical rather than physical methods." However, there are still a great number of physical methods being explored and investigated, which the metallurgist with little training in physics is hardly prepared to use. For these people, this book has been destined. Geometrical optics, interference, diffraction, polarization and light-sources are discussed. These latter lead to spectrographic analysis and are dealt with in five chapters in simple language and illustrated with numerous clear sketches. The reproduction of photomicrographs, chosen for examples, is excellent. Of course, the author does not intend to give an exhaustive treatise on the subject for such a task could be carried out only in voluminous text books. This little book, however, offers a well rounded and clear picture of the optical methods available for the investigation of metals. This has been done so successfully that one can but look forward to a second volume dealing with other physical methods used in the metallurgical field.

CHEMISCHE - TECHNISCHE UNTERSUCHUNGSMETHODEN, ERGANZUNGSWERK ZUR ACHTEN AUFLAGE. Edited by *J.D'Ans*. Published by Julius Springer Verlag, Berlin, Germany. 2 volumes, 1300 pages. Price RM 84.

THE FIRST of the two volumes deals with chemical methods and operations in general. Thus the reader finds articles on qualitative analyses, electroanalyses, optical methods and the like. Additional chapters follow dealing with more modern procedures developed within the last few years. These procedures include polarography, chromatography and fluorescence. These latter are efficiently described by Drs. Heyrovsky, Hesse and Haitinger respectively. Of especial interest are the chapters on micro-chemistry written by Drs. Benedetti-Pichler of New York University and Lieb of Graz, Austria. Dr. Loewe, the well known designer of the Carl Zeiss optical plant at Jena does his share in contributing a most illuminating chapter on this subject.

The second volume consists largely of reports by industrial chemists on technical methods of operation. The reader will find valuable information on the subjects of testing and analysis of fuel oil, gas and tar, the chemistry of water and

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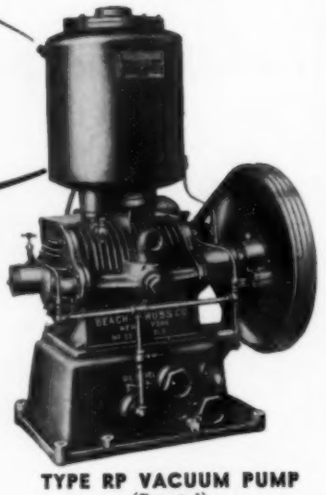

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These charts were prepared by Prof. Ernst Berl, Research Professor at Carnegie Institute of Technology for "Chem. & Met." Price . . . 75¢

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food analysis. The book ends with a few chapters on the manufacture of various chemicals, fertilizers, inorganic colors, glass and ceramics and about thirty metallic products. A third volume on organic chemical processes is still in preparation.

A comprehensive bibliography is appended to each chapter, thus making it very easy for the interested reader to acquire more information on the various subjects. Many American journals are frequently quoted. On the whole, the work should be a valuable addition to the chemical library.

GRAPHIC PRESENTATION. By *Willard Cope Brinton*. Published by Brinton Associates, New York, N. Y. 512 pages. Price $5.

Reviewed by *S. D. Kirkpatrick*.

TWENTY-FIVE YEARS AGO when charts were regarded almost exclusively as accessories to scientific and engineering reports, the author published his first book on "Graphic Methods for Presenting Facts." It had scarcely appeared before the World War created a feverish demand for prompt and reliable data of all kinds, and those engineers who were adept in graphic chart technique were called into a wide variety of services. Mr. Brinton was one of these whose world-wide activities extended from charting silk shipments in the Orient to the graphic control of munitions plants in New England and the scheduling of food shipments to the Belgian Relief Commission.

From this experience he derived a lasting interest in graphic charts and in human reactions to them. This became a hobby—almost a fetish. He had no intention of writing another book, yet he could not resist the temptation of "tearing from magazines and newspapers literally thousands of examples of particularly interesting or especially erratic graphic charts." He became a great student and admirer of William Playfair, friend of Thomas Jefferson, and author of "Lineal Arithmetic" published in 1798. To him Mr. Brinton dedicates this most unusual exposition of the many ways in which modern science and industry are utilizing the technique of lineal artithmetic.

In 45 chapters, charts are tabulated and discussed by types, i.e. sector, bar, pictorial, map and by purpose or subject matter, i.e. geneological, organization, rating, chronological, progress and flow charts. Then a final 15 chapters deal with methods of preparing charts and the physical and mechanical accessories required. The entire book is profusely illustrated—so much so that it suffers from apparent lack of continuity. Yet if it is used for reference purposes, as the author suggests, the reader can take advantage of its unique edge markings and quickly spin the pages to any desired chapter. The book contains other innovations in typography and in the use of color, which in this reviewer's opinion do not necessarily add to its value or the attractiveness of its appearance. However, any engineer or business man who is looking for an interesting and compre-

hensive collection of charts will find that and a lot more in "Graphic Presentation."

YOUR INCOME TAX. 1940 edition. By *J. K. Lasser*. Published by Simon & Schuster, New York, N. Y. 128 pp. Paperbound. Price $1.

FREQUENT CHANGES in statutes and their administration have created a real need for an annual summary of the pressing problem most of us must face on March 15 of each year. Proof of this may be found in the fact that in recent years this little book by one of our best known accountants and auditors has numbered among the best sellers in the shops and on the newsstands. Professional men and salaried employees in many technical pursuits will find its check lists an easy and perhaps profitable way to decide on knotty problems of what can and cannot be deducted from their reported incomes. Did you know, for example, that you can deduct the cost of your subscription to *CHEM. & MET.* as well as your dues in engineering societies?

TEXT BOOKS

EINLEITUNG IN DAS STUDIUM DER CHEMIE. By *J. Remsen*. Revised by Dr. *Hans Reihlen*. Published by Theodor Steinkopf, Dresden and Leipzig, German. 324 pages. Price RM 7.50

THIS WELL KNOWN chemistry textbook, formerly published under the names of both Remsen and Seubert, now appears in its 10th edition, but is almost unrecognizable in the garb in which Dr. Reihlen has revised it. The present volume has been very much modernized and reorganized. For example, special emphasis is now placed on the technical aspects of chemistry. This, of course, is in accord with the reform of chemical education recently begun in Germany. Thus, much additional space is now devoted to the treatment of carbon, iron ores, silicates etc. Furthermore, there are special sections on the concentration of poor ores, production of sulphur in illuminating gas plants, inert gases from air and other industrial subjects not usually included in a textbook of beginning chemistry. There are two interesting chapters on nuclear processes with neon radiation and the Clusius method for isotope separation.

As in previous editions, numerous simple, but very impressive sketches amplify the text and care has been taken to give sufficient problems to clarify the various subjects in the mind of the student.

PRINCIPLES OF CHEMISTRY. By *Joel H. Hildebrand*. 4th Edition. Published by The Macmillan Co., New York, N. Y. 358 pages. Price $2.50.

THIS WELL KNOWN TEXT BOOK for freshman chemistry students now appears in its fourth edition. Dr. Libby, the author's colleague has contributed much to the book by revising the chap-

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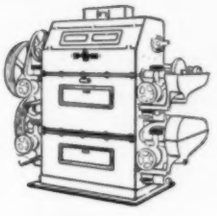

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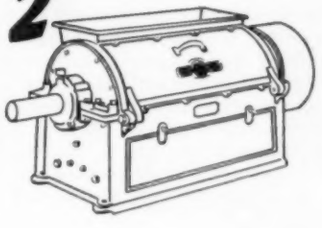

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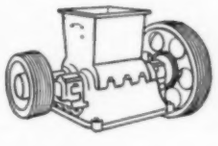

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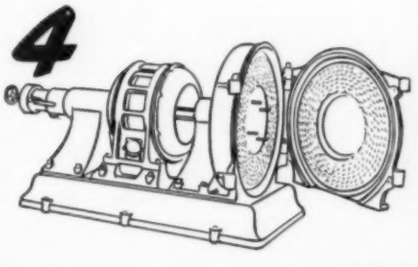

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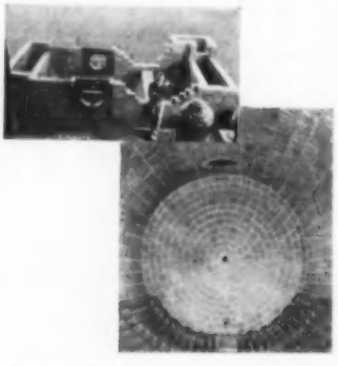

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ters on the relation of chemical and physical behavior to atomic structure. Some mention is made of Broensted's theory of acids and bases, but the chapters on reaction kinetics and equilibria deserve special mention for their clearness of style and well chosen examples. Much emphasis is placed on theory and less on the pure chemistry of elements and their compounds. The analogies drawn in other fields as, for example, activation energy by means of a mechanical model, may prove very helpful.

A COURSE IN GENERAL CHEMISTRY. By *William C. Bray* and *Wendell M. Latimer*. Third Edition. Published by The Macmillan Company, New York, N. Y. 206 pages. Price $1.60.

A COMPLETE LABORATORY manual for those college freshmen studying chemistry and using Hildebrand's book as their main text. The experiments are carefully selected and the appendices contain detailed information on the use of the balance, glass bending and various other chemical laboratory operations.

LECTURE DEMONSTRATIONS IN GENERAL CHEMISTRY. By *Paul Arthur*. Published by McGraw-Hill Book Co., Inc., New York, N. Y. 455 pages. Price $4.

DETAILED INSTRUCTIONS for performing more than one thousand demonstration experiments will probably make this volume a welcome and valuable addition to the chemistry teacher's equipment. While the book is not intended for use with any single textbook, it has been designed so that users of any standard text can easily find desired information. Directions for experiments are clear, each is accompanied by a brief statement of principles involved and original literature references are given. The book is well illustrated with diagrams which will aid in setting up and constructing apparatus.

HEATING VENTILATING AIR CONDITIONING GUIDE 1940. Published by the American Society of Heating and Ventilating Engineers, New York, N. Y. 1184 pages. Price $5.

THE EIGHTEENTH EDITION of this reference manual has just appeared. It is devoted exclusively to the subjects of heating, ventilating and air conditioning and related data on refrigeration and is compiled by men active in the profession and the allied industries. The book is divided into two parts, a technical data section and a catalog data section on manufacturers' equipment. Beyond the addition of certain amount of new data the principal improvement of this edition over the last appears to be one of format. A lighter weight paper has been used and the text condensed and consolidated so that the book as a whole is much less cumbersome and easier to handle. The technical section is equipped with a chapter index as well as a detailed subject index.

The products described by manufacturers in the Catalog Data Section have been divided into five groups and the contents of each division outlined on a title page and cross references to relevant matter in the Technical section. Lastly, there is an index to Modern Equipment.

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Biennial Census of Manufactures, 1937—Part I. This volume gives detailed final statistics for manufacturing and printing and publishing industries in 1937, as compiled biennially by the Census. Bureau of the Census; $2.25 (clothbound).

Cumulative Supplement to "Changes in Import Duties Since the Passage of the Tariff Act of 1930," January, 1940. U. S. Tariff Commission; mimeographed pamphlet.

Analysis of Miscellaneous Chemical Imports through New York in 1938. U. S. Tariff Commission; mimeographed.

Effect of Trade Agreements on Rates of Duty. U. S. Tariff Commission; mimeographed.

Pre-Agreement and Post-Agreement Trade of the United States. U. S. Tariff Commission; mimeographed.

Important Import Items Affected by Trade Agreements. U. S. Tariff Commission; mimeographed.

Synthetic Organic Chemicals, United States Production and Sales 1938. U. S. Tariff Commission. Report No. 136 (Second Series); 10 cents.

Twenty-third Annual Report of the U. S. Tariff Commission, 1939; 10 cents.

Raw Materials Bibliography. U. S. Tariff Commission; mimeographed 85-page compilation.

Corrugated Metal Diaphragms for Aircraft Pressure-Measuring Instruments, by W. A. Wildhack and V. H. Goerke. National Advisory Committee for Aeronautics, Technical Notes No. 738; mimeographed.

Sound Absorption Coefficients of the More Common Acoustic Materials. National Bureau of Standards, Letter Circular 573; mimeographed.

Survey of Roofing Materials in the Northeastern States, by Hubert R. Snoke and Leo J. Waldron. National Bureau of Standards, BMS 29; 10 cents.

Structural Properties of "Insulite" Wall and "Insulite" Partition Constructions, by Herbert L. Whittemore and Ambrose H. Stang. National Bureau of Standards, BMS 31; 15 cents.

Judging Fabric Quality, by Bess Viemont Morrison. U. S. Department of Agriculture, Farmers' Bulletin No. 1831; 5 cents.

The Vitamin B Content of Foods in Terms of Crystalline Thiamin, by Lela E. Booher and Eva R. Hartzler. U. S. Department of Agriculture, Technical Bulletin No. 707; 5 cents.

Method and Procedure of Soil Analysis Used in the Division of Soil Chemistry and Physics, by W. O. Robinson. U. S. Department of Agriculture, Circular No. 139; 5 cents.

The Acidic Properties of Peat and Muck, by Irvin C. Feustel. U. S. Department of Agriculture, Technical Bulletin No. 690; 10 cents.

Soybeans: Culture and Varieties, by W. J. Morse and J. L. Canter. U. S. Department of Agriculture, Farmers' Bulletin No. 1520; 10 cents.

Labeling Pyrethrum Powder (Insect Powder) and Preparations Containing it. Food and Drug Administration; mimeographed.

Price Fixing by Government in the United States, 1926–1939. U. S. Department of Agriculture, Agricultural Economics Bibliography No. 79; mimeographed.

Fuel Data. The Bureau of Mines has published the following statistics: Pennsylvania Anthracite Tables, 1938; Coke and Byproduct Tables, 1938; Lignite Tables, 1938; Anthracite and Semianthracite Outside of Pennsylvania Tables, 1938. Available upon request from the Coal Economics Division, U. S. Bureau of Mines, Washington, D. C.

Mineral Statistics for 1939. The Bureau of Mines is now issuing preliminary statistics on production in 1939 of various metals and minerals. Among those issued thus far are: Lead and zinc pigments and sinz salts, M.M.S. 799; Cadmium industry, M.M.S. 800; mimeographed.

Survey of Fuel Consumption at Refineries in 1938, by G. R. Hopkins. U. S. Bureau of Mines, Report of Investigations 3485; mimeographed.

Properties of Louisiana Crude Oils, II—Additional Analyses, by E. L. Garton. U. S. Bureau of Mines, Report of Investigations 3476; mimeographed.

Recovery of Nickel, Copper, and Precious Metals from Domestic Ores by a Combined Electrothermal and Electrolytic Method, by J. Koster et al. U. S. Bureau of Mines, Report of Investigations 3483; mimeographed.

Correlation of Analysis of Coal with the Products of Carbonization in Externally Heated Retorts, by V. F. Parry. U. S. Bureau of Mines, Report of Investigations 3482; mimeographed.

TNEC Hearings. Publication of the following series of hearings on Investigation of Concentration of Economic Power has been announced, as follows: Part 1—Economic Prologue; Part 2—Patents (Automobile and Glass Container Industry); Part 3—Patents (Proposals for Changes in Law and Procedure); Part 4—Life Insurance; Part 5—Monopolistic Trade Committee Report on Monopolistic Practices in Industries; Part 5A—Federal Trade Commission Report on Monopolistic Practices in Industries; Part 6—Liquor Industry; Part 7—Milk Industry, and Poultry Industry. Available from Temporary National Economic Committee, Room 281, Apex Bldg., Washington, D. C.

Gravel and Sand Deposits of Eastern Maryland Adjacent to Washington and Baltimore, by N. H. Darton. U. S. Geological Survey, Bulletin 906-A; $1.25.

Federal Specifications. O-A-51a, Amendment 2—Acetone; HH-M-611—Mortar; Air-Setting, Refractory, Bonding, (Wet-Type); 5 cents each.

Dermatitis Caused by a New Insecticide, by Louis Schwartz and Leon H. Warren. U. S. Public Health Service, Public Health Reprint No. 2095; 5 cents.

The Solubility of Lead Arsenate in Body Fluids, by Lawrence T. Fairhall. U. S. Public Health Service, Public Health Reprint No. 2097; 5 cents.

Disabling Morbidity Among Employees in the Soap Industry, 1930–34, Inclusive, by Hugh P. Brinton and Harry E. Seifert. U. S. Public Health Service, Public Health Reprint No. 2093; 5 cents.

Directory of State and Insular Health Authorities, July 1, 1939. U. S. Public Health Service, Public Health Reprint No. 2110; 5 cents.

International Traffic in Arms, Seventh Edition. Department of State, Publication 1407; 10 cents.

Annual Report of the Federal Trade Commission for Fiscal Year Ended June 30, 1939. Summarizes pending cases and operating policy of Federal Trade Commission; 30 cents.

Annual Report of Tennessee Valley Authority for Fiscal Year Ended June 30, 1939; 75 cents.

Food and Drug Report. Report of the Chief of the Food and Drug Administration, 1939; 5 cents.

Annual Report of the Secretary of the Interior, Fiscal Year Ending June 30, 1939. Includes report for Bureau of Mines and U. S. Geological Survey; 75 cents.

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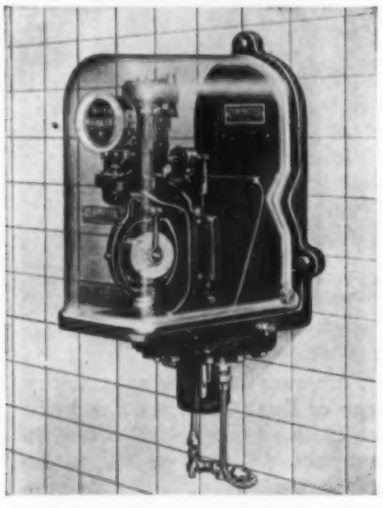

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MODERN STEELS. Editor, *Ernest E. Thum.* Published by The American Society for Metals, Cleveland, Ohio. 374 pages.

A SERIES OF LECTURES which was successfully given to a large group in Pittsburgh by such well known metallurgical experts as F. H. Allison, A. W. Demmler, G. R. Fitterer, J. P. Gill, M. W. Lightner and E. E. Thum is presented in this little volume. The thirteen articles by the six authors cover the manufacture, inspection, treatment and uses of modern steels. The book is not chemical in its treatment, but rather is it a practical work dealing comprehensively with the treatment of various problems encountered in steel metallurgy. The charts, photographs, microphotographs and figures are excellent.

The collected lecture notes have been expanded by suggestions for further reading and groups of examination questions written in the modern manner.

POSSIBILITIES FOR THE INDUSTRIAL DEVELOPMENT OF TEXAS. By *W. Lee O'Daniel*, Governor of Texas. Executive Department, Austin, Texas. 62 pages.

A SUMMARY of industrial status and potentialities, considering such factors as raw materials, markets, labor, power and financial resources. This document would be of interest to any company which is considering the possibility of a location on the Gulf Coast or in the Southwest.

THE MEXICAN OIL SEIZURE. By *Donald R. Richberg.*

A report published and distributed by Standard Oil Company (New Jersey), 30 Rockefeller Plaza, New York, N. Y.

THIS IS A REPORT on the investigations by Donald Richberg on behalf of American petroleum companies seeking adjustment of their claims against the Mexican government following expropriation of the foreign owned properties.

DIRECTORY OF NEW ENGLAND RESEARCH AND ENGINEERING FACILITIES. Published by Engineering Societies of New England, Inc., Boston, Mass. 118 pages. Price $2.

THIS DIRECTORY gives in comprehensive detail the facilities, experience and industries served by over 300 private consultants and all of the colleges and universities in New England having laboratory and research facilities. There is an index by types of service rendered covering all 1,300 different services recorded in the directory. There is also an alphabetical list by companies. The data about each firm include facilities, experience, industries served and types of services rendered by each together with the educational and business background of each key member of the firm.

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MARKET INFORMATION

Chem & Met's Market Research department has published a 32-page booklet which is offered free on request to advertisers and their advertising agencies. Write to Chem & Met, 332 W. 42nd St., New York for "Industries Biggest Buyers".

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POST'S PAPER MILL DIRECTORY. Published by L. D. Post, Inc., New York, N. Y. 602 pages. Price $2.

IN A HANDY SIZED VOLUME this directory covers all of the Pulp and Paper mills of the United States and Canada. Separate reports on each mill give the name and location of the mill, the names of the officers, data on the major units of mechanical equipment, grades of paper and pulp produced and capacity in twenty-four hours. A separate section lists more than 850 grades and kinds of paper and pulp and the manufacturers of each.

Finally there is a special section citing statistics covering production of the industry during the last three years and data on the equipment and capacity of the industry as a whole.

MINIMUM LIST OF RECOMMENDED BOOKS FOR A CHEMICAL ENGINEERING LIBRARY. Prepared by Chemical Engineering Education Committee of the American Institute of Chemical Engineers, New York, N. Y. 10 pages. Mimeographed.

TWO SEPARATE LISTS are contained in this little pamphlet. The first is a minimum list of 75 recommended books and the second is a supplementary list, very useful but not necessarily compulsory for the chemical engineer. The material is divided into two sections: an alphabetical list according to author and a classified one according to subject matter.

Not only are the most widely used books directly in the field of chemical engineering given, but also certain books in related fields such as Mathematics, Chemistry and other branches of engineering. In the event that there is more than one book on the given subject, the committee has selected one merely as representative of the group and does not imply that only this particular book should be made available.

THE NATIONAL PAINT DICTIONARY. By *Jeffrey R. Stewart.* Published by Stewart Research Laboratories, Alexandria, Va. 154 pages. Price $5.

A COMPREHENSIVE GLOSSARY of the materials and technical devices used in the manufacture of protective and decorative coatings condensed into 154 pages. The material contained herein appeared monthly in "Drugs, Oils & Paints" starting with May 1937 and running until September 1939. Mr. Stewart then took this series of articles and supplementing it with the new materials and devices which are continuously appearing in a progressive industry compiled this dictionary.

The volume includes definitions of trade names and raw materials used in the paint and allied industries, descriptions and illustrations of laboratory equipment used as well as methods of analysis.

This book should serve as a handy reference not only to those engaged in the manufacture of paints and varnishes but to purchasing agents, salesmen, production managers and various types of technologists.

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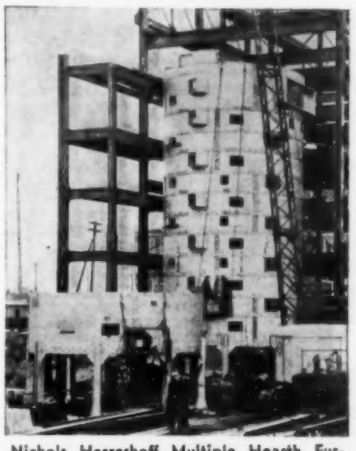

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Manufacturers' LATEST PUBLICATIONS

Chemicals. The Enthone Co., 440 Elm St., New Haven, Conn.—Leaflet describing Pickleen, a new liquid wetting and penetrating agent for improving performance of sulphuric and hydrochloric acid metal pickles by reducing dragout losses and metal attack.

Control. The Bin-Dicator Co., Detroit, Mich.—8-page leaflet briefly describing this company's Bin-Dicators for automatically controlling level of solid materials in bins and hoppers.

Conveyors. Aluminum Ladder Co., Tarentum, Pa.—8-page leaflet describing this company's wheel type and roller type of portable aluminum gravity conveyors for boxes, cartons and other packages.

Cranes. Whiting Corp., Harvey, Ill. —Loose-leaf crane catalog of individual folders, data sheets and catalogs, describing this company's numerous types of overhead cranes and accessories, including also gantry cranes.

Cycle Control. The Permutit Co., 330 West 42d St., New York, N. Y.—Leaflet describes this company's master pilot valve for either manual or automatic controlling of cyclic process operations in which a number of steps in valve manipulation are repeated at regular intervals in the same sequence.

Editorials. Link-Belt Co., 307 North Michigan Ave., Chicago, Ill.—64-page reprint book of selected editorials taken from this company's house organ, "Link-Belt News," selected for broad general interest and mostly of a philosophical and inspirational nature; mostly written by prominent authors for original publication in well-known periodicals.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—GEA3179A —4-page leaflet describing the Type CR7501-K Phano-Charger, an adjustable self-regulating battery charger for maintaining storage batteries by the floating method of charge.

Electrical Equipment. Reliance Electric & Engineering Co., Ivanhoe Road, Cleveland, Ohio—Bulletin 220—2-page leaflet describes construction details of this company's explosion-proof fan-cooled d.c. motors.

Electrical Equipment. United Cinephone Corp., 43-37 Rawson St., Long Island City, N. Y.—Leaflet describing this company's new electronic switch for use with thermostats, limit switches and other devices requiring low contact pressures or limited movement.

Equipment. Edward G. Budd Mfg. Co., Philadelphia, Pa.—8-page booklet on this company's methods of fabricating stainless steel process equipment by the "Shotweld" process, describing the process in considerable detail and showing types of equipment so fabricated.

Equipment. Fansteel Metallurgical Corp., Chicago, Ill.—Form TA-3904—8 pages describing in detail construction and operating characteristics of this company's absorption systems for hydrochloric acid gas for the production of high-strength acid in extremely compact equipment.

Equipment. International Filter Co., 325 West 25th Place, Chicago, Ill.— Bulletin 100—12 pages on this company's aerators in forced draft, cone, tray and cascade types. Also Bulletin 350-A, 8 pages on this company's mixers and feeders for chemical solutions in water, sewage and process liquid treatment.

Equipment. Pittsburgh Piping & Equipment Co., Pittsburgh, Pa.—"The Stainless Fabricator," 4-page house organ put out by this concern to describe its manufacturing facilities and types of equipment fabricated from stainless steel for process industries.

Equipment. F. J. Stokes Machine Co., Tabor Road, Philadelphia, Pa.—14-page booklet describing this company's completely automatic molding machinery for thermo-setting materials, with information on two types of molding press and on types of articles molded. Compares delivery time and molding costs with semi-automatic machinery.

Filters. The Enthone Co., 440 Elm St., New Haven, Conn.—Leaflet describing this company's high-strength filter-press paper for use over filter cloths to facilitate cleaning.

Fire Extinguishers. Pyrene Mfg. Co., 560 Belmont Ave., Newark, N. J.—New circulars dealing respectively with 2½-gal. extinguishers, 1- and 1½-qt. vaporizing liquid extinguishers, and a brief discussion and chart presentation of various types of extinguishers and their applications.

Fittings. The American Brass Co., Waterbury, Conn.—Anaconda Publication B-9—16-page booklet on copper and Everdur fabricated and welded fittings for large pipe lines, available in tees, reducing tees, reducers, elbows, crosses, Y's and other forms in sizes to 24 in. I. D.

Fused Silica. The Thermal Syndicate, Ltd., 12 East 46th St., New York, N. Y. —Bulletin 3—4-page booklet on properties, dimensions, prices and uses of vitreous silica gas sampling tubes.

Instruments. The Foxboro Co., Foxboro, Mass.—Publications as follows: Bulletin 240, 8 pages on potentiometer type indicating recorder-controllers, describing certain parts and construction features in detail with reference to electric two-position controllers, electric throttling controllers and air-operated throttling controllers; Bulletin 241, 8 pages on time and sequence systems for automatic process operations, describing this company's cycle controllers and their combination with other instruments for complete control systems; Catalog DMF797, 4 pages on remote electric transmission instruments for measurement and control, describing particularly remote indication and recording of water supplies.

Instruments. Leed & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa.— Catalog N-33B—40 pages on recording and controlling Rayotube radiation thermocouple pyrometers utilizing Micromax and Speedomax potentiometric recorders and controllers. Illustrates many types of installations.

Instruments. The Lewis Engineering Co., Naugatuck, Conn.—6-page leaflet describing this company's portable potentiometer pyrometers, accessories and thermocouples.

Instruments. The Mercoid Corp., 4201 Belmont Ave., Chicago, Ill.—Bulletin V-4—8 pages on this company's light-actuated control system for guarding against flame or power failure in industrial type oil and powdered coal burners.

Instruments. Pittsburgh Equitable Meter Co., 400 North Lexington St., Pittsburgh, Pa.—16-page booklet briefly describing advantages of use of fluid meters and describing the numerous types of liquid and gas meter made by this company.

Joints. American District Steam Co., North Tonawanda, N. Y.—Bulletin 35-20A—8 pages on this company's internally-externally guided expansion joints in sizes from 1¼ to 20 in., with specifications, dimensions, weights and list prices.

Lubricants. E. F. Houghton & Co., First, American & Somerset Sts., Philadelphia, Pa.—4-page leaflet describing this company's "Vital" extreme-pressure lubricants for gears. These hydrocarbon treated oils are claimed to carry three to five times the load of untreated oils.

Metal Treatment. Pyrene Mfg. Co., 560 Belmont Ave., Newark, N. J.— Booklet AD229—8 pages describing a new aluminum-treating process developed by this company under the name of Pylumin, intended for inexpensive production of satisfactory paint-base coatings on aluminum and aluminum alloys.

Metal Hose. Chicago Metal Hose Corp., Maywood, Ill.—Bulletin SS-16—4 pages on this company's Rex-Bellows stainless steel divided flexible units; also Bulletin SS-1, 4 pages on types, advantages and dimensions of stainless steel bellows.

Mixing. Hendrick Mfg. Co., Carbondale, Pa.—4-page reprint of an article by A. Brothman and H. Kaplan, describing the results of new investigations of liquid mixing which have made possible accurate power and performance prognostications based on laboratory tests.

Packing. Chicago Belting Co., Green and Washington Sts., Chicago, Ill.— "Handbook of Hydraulic and Pneumatic Leather Packings," a 50-page spiral-bound book prepared and copyrighted by the engineering department of this company, dealing with design and application of packings. Contains much information in a field containing practically no earlier published literature. Contains complete dimensions and numerous dimensioned sketches; also specifications, price lists and general information. Book is available free to heads of engineering departments and designing engineers only in industrial plants using packings either for replacement or standard equipment.

Pharmaceuticals. The Norwich Pharmacal Co., Norwich, N. Y.—36-page book of the "plant visit" type, describing largely with photographic reproductions this company's research, control and manufacturing operations in connection with a broad range of pharmaceutical products.

Power Transmission. B. F. Goodrich Co., Akron, Ohio—Catalog Section 2180 —24 pages plus price list on fractional-horsepower V-belts. Devoted largely to design of such drives. Gives much tabular and charted engineering information.

Pumps. Beach-Russ Co., 50 Church St., New York, N. Y.—Bulletin No. 73 —2-page leaflet describing this company's test and portable laboratory type rotary vacuum pumps and blowers.

Pumps. Peerless Pump Co., 301 West Avenue 26, Los Angeles, Calif.—New literature entitled "100,000 Raindrops From Underground for 1 Cent," featuring various types of deep-well pumps of turbine and helical rotor types made by this company.

Pumps. Milton Roy, 3160 Kensington Ave., Philadelphia, Pa.—Leaflet describing this company's small-size hypochlorite pumps for handling hypochlorite or chlorine solutions in capacities from 1 to 10 gal. per hr. for water treatment.

Scales. Toledo Scale Co., Toledo, Ohio.—16-page broadside describing this company's truck scales, with information on applications and mechanical features.

Steam Generation. Elliott Co., Jeannette, Pa.—Bulletin H-10—32-page book on this company's steam turbine-generators, illustrating and describing various types with numerous photographs and drawings. Also gives charts for estimating the performance of turbo-generators.

Traps. Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.— Publication 2925—4-page leaflet describing this company's Multiport Drainer, a large-capacity steam trap equipped with a balanced rotary type valve positioned by a float, designed for continuous discharge of condensate.

Tubes. The Babcock & Wilcox Tube Co., Beaver Falls, Pa.—Technical Data Card No. 3—Gives decimal equivalents in average wall and minimum wall of tubular materials for fractional inches and Birmingham Wire Gage.

Chemical ECONOMICS and MARKETS

PRODUCTION OF CHEMICALS AT UNCHANGED LEVELS WITH SLIGHT DROP IN CONSUMPTION

THE chemical industry entered the year with operating rates practically unchanged from those which prevailed in December. Reports credit plants to be working to capacity which in certain cases is made necessary by the fact that producers have not yet caught up with their deliveries due on existing contracts. The consuming industries have shown a varied status during the month with some of them maintaining former rates of operation and others subject to curtailment. From trade reports and partial data for operations it would appear that production has been gaining on consumption. The preliminary index for consumption of chemicals approximates 136.50 for January which compares with 114.97 for January 1939 and with the revised index of 138.16 for last December.

***Chem. & Met.* Index for Consumption of Chemicals**

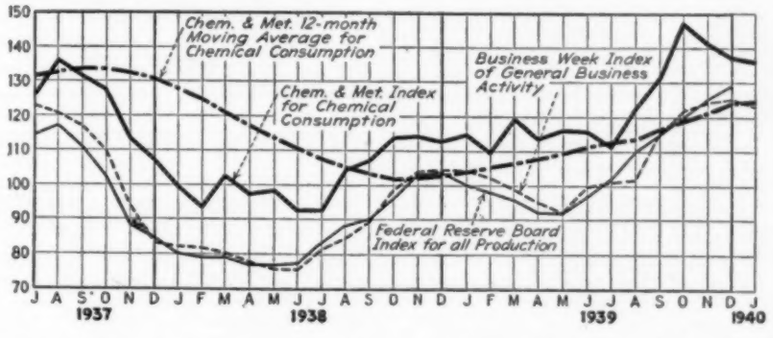
	November revised	December
Fertilizer	32.81	31.98
Pulp and paper	19.30	18.07
Glass	12.34	12.30
Petroleum refining	13.69	13.88
Paint and varnish	9.89	8.70
Iron and steel	11.82	11.40
Rayon	11.08	11.10
Textiles	9.07	8.05
Coal products	8.91	9.01
Leather	3.88	3.70
Explosives	5.18	4.45
Rubber	3.33	2.96
Plastics	2.50	2.56
	143.80	138.16

With the continued strong demand for chemicals in the export trade it is almost assured that production will continue to outstrip domestic consumption which is necessary if a surplus is to be found for filling export orders. General business suffered some reaction in January and naturally this had some bearing on consumption of chemicals as some of the consuming industries which cut down operations are large consumers of chemicals. This was by no means a general situation, however, as far as use of chemicals is concerned. Some consumers are maintaining high operating schedules and, as in the case of rayon with further plant capacity just announced, will in all probability surpass their average rates for last year. Inventories of finished goods may at times exert some influence of the rate of chemical consumption but many basic industries are in such a strong position that any drastic fall in demand seems remote.

Among the consuming branches which are moving forward are rayon, pulp and paper, glass, and plastics. The outlook is favorable for paint and varnish, rubber, fertilizer, and coal products and the chemical industry is steadily extending its own consumption of raw materials. The fact that certain chemicals formerly imported are now being made in this country adds to the probabilities of enlarged consumption of chemicals this year within the chemical industry.

The trend of business in January as defined by the adjusted index of the Federal Reserve Board was sharply down from the position maintained in December but normally there is a rise in the index in January so in the present case the decline in steel operations and in some other branches of general industry combined with the influence of reversed seasonal factors indicate a rather abrupt change in industrial activity which will not seem so startling when interpreted in the light of these factors.

The report prepared by the Bureau of the Census in cooperation with the National Association of Credit Men states that sales of manufacturers for the calendar year 1939 increased 12.5 per cent over those for the preceding year. The report is a compilation of the results of 1,613 manufacturers. The percentage gain for chemicals and related products was given as 19.3 which means that chemical sales were relatively higher than those for general business. Comparing sales for December with December 1938 and with November 1939, the percentage changes for all industry were up 14.6 and down 5.6 respectively. For chemicals and allied products the changes reported were up 21 and down 9.6.


Chem. & Met. 12-month Moving Average for Chemical Consumption
Business Week Index of General Business Activity
Chem. & Met. Index for Chemical Consumption
Federal Reserve Board Index for all Production
150
140
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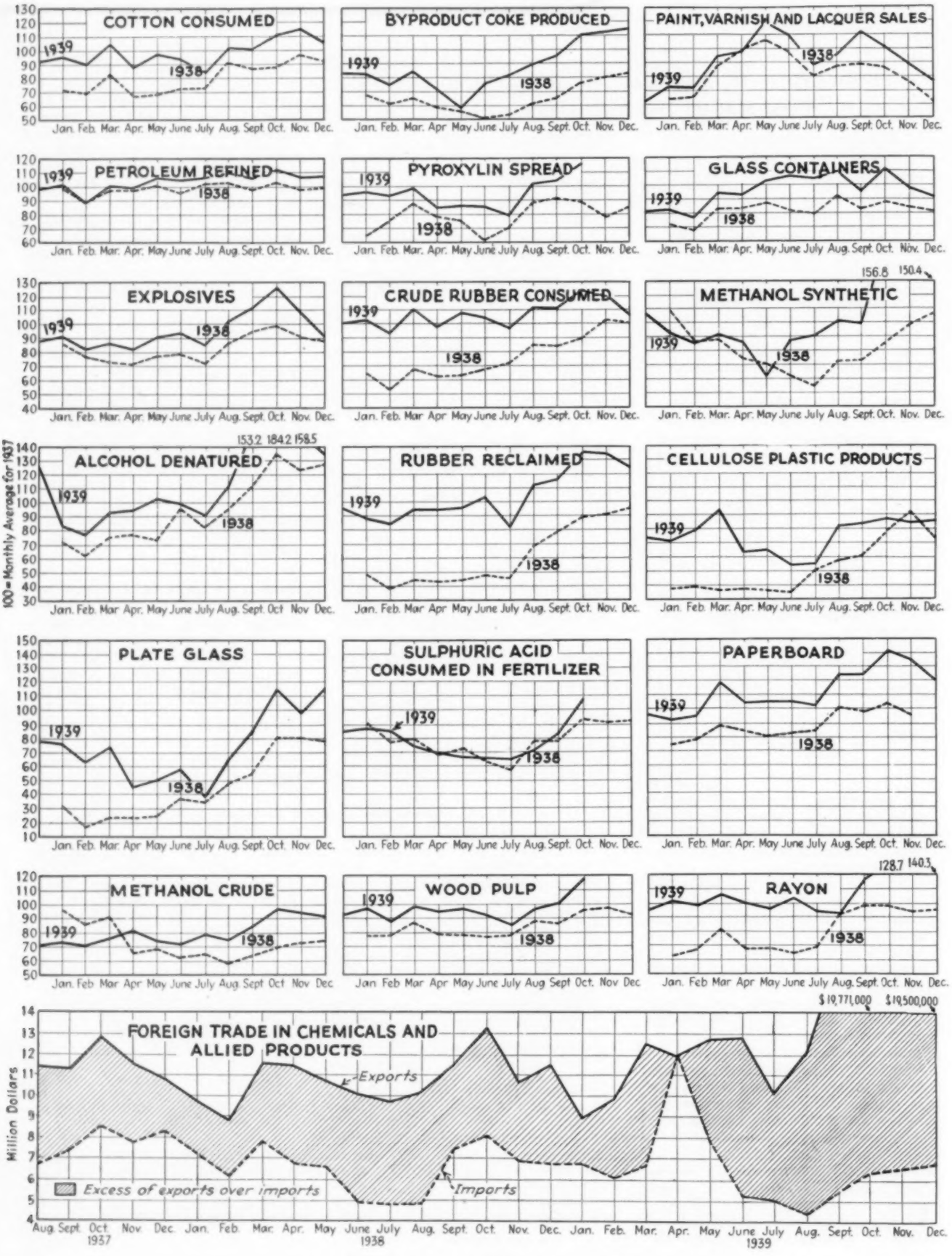
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J
1937
1938
1939
1940

Production and Consumption Data for Chemical-Consuming Industries

	December 1939	December 1938	January-December 1939	January-December 1938	Per cent of gain for 1939
Production					
Alcohol, ethyl, 1,000 pr. gal	22,080	16,781	221,618	192,678	15.0
Alcohol, denatured, 1,000 wi. gal	11,158	10,478	113,618	92,904	21.5
Ammonia, liquor, 1,000 lb	4,897	3,979	48,207	40,726	18.7
Ammonium sulphate, tons	60,455	45,837	578,538	436,937	32.4
Benzol, 1,000 gal	11,536	7,802	102,470	74,094	38.3
Byproduct coke, 1,000 tons	4,718	3,363	43,031	31,658	35.9
Glass containers, 1,000 gr	4,046	3,519	51,228	43,163	18.7
Plate glass, 1,000 sq. ft	18,477	12,691	141,741	85,726	65.3
Window glass, 1,000 boxes	1,189	1,003	10,778	6,629	62.6
Methanol, crude, gal	434,021	357,249	4,659,589	4,170,096	11.7
Methanol, synthetic, gal	4,184,479	2,844,249	34,255,699	26,031,169	31.6
Cellulose acetate plastics					
Sheets, rods, tubes, 1,000 lb	987	1,112	9,141	6,831	33.8
Molding material, 1,000 lb	1,183	758	11,655	7,394	57.6
Nitrocellulose plastics, 1,000 lb	1,089	789	13,373	9,478	41.1
Rubber reclaimed, tons	19,249	15,899	195,243	136,243	42.8
Consumption					
Cotton, bales	652,695	565,627	7,371,420	5,903,701	24.7
Silk, bales	21,128	35,204	383,431	411,794	*6.9
Wool, 1,000 lb	30,043	39,189	396,413	284,507	39.3
Rubber, crude, tons	48,428	48,143	577,591	427,177	35.2
Waste paper, tons	283,228	221,768	3,438,935	2,788,071	23.3

* Per cent of decline.

Production and Consumption Trends



DELIVERY OF CHEMICALS CONTINUED ON HIGH PLANE THROUGHOUT LAST MONTH

SHIPPING instructions for delivery of chemicals against contracts showed no signs of a let-up last month and some producers are reported to be keeping plants at full capacity to take care of consuming demand. This is especially true for soda ash so much so that plants have even been pushed beyond normal capacities. Interest in spot chemicals has been less keen but some selections remain well sold ahead and relatively high prices prevail for amounts which find their way to market. With the turn of the month some slowing up in the movement of mineral acids and other chemicals was reported with certain consuming industries, shaping their raw material supplies in accord with the movement of their own products.

Prices for chemicals, exception being made for the small lot buying of scarce products, have held a very steady course with metal salts following the course of the metal markets and therefore subject to varying fluctuations both up and down. Solvents are in a strong position and the most important change in the last month was the sharp rise in quotations for spirits of turpentine with smaller-than-usual receipts coming to primary distributions points. The fact that contracts account for the bulk of chemicals which will be delivered in the first quarter gives assurance that there is a stability which is a guarantee that the movement one way or the other will not be important. As the year advances many situations may arise which will be of price significance and unless the war terminates suddenly very few of these influences can be regarded as favoring price reductions. Last year some chemicals were selling at or below production costs. This condition followed as a result of excess of supplies over demand and the sales competition which arose from that condition. More recently this condition has changed for the better and unless there is a reversal, the trend for those products should be upward. Any consideration of future values must revert to one's opinion regarding the future position of business in general with a reservation in cases where raw materials are subject to outside influences which may arbitrarily govern sales schedules for the finished products.

Prices for oils and fats, on the other hand, have carried an easier undertone with moderate declines fairly general throughout the list. Exceptions are found in the case of China wood oil and castor oil both of which are affected by conditions in outside markets.

Prices for high grade chrome ore have recently been marked up and this has a strengthening effect of bichromates. Incidentally the British Minister of Supply has recommended that bichromates, including their derivatives, temporarily be withheld from manufacturers of pigments or paints except for the purpose of camouflage or ship paints. It is also recommended that the production of chrome oxide by bichromate manufacturers, for the manufacture of pigments shall be reduced by 160 tons a month. The reasons given are that a shortage of bichromates has been experienced by textile and leather firms working on government contracts. It is further stated that bichromates are urgently needed in India and Australia for production of military service materials which adds to the importance of conservation.

January tax tag sales in 17 States represented 428,643 tons, according to reports by State control officials to The National Fertilizer Association. The total was 5 per cent less than a year ago and 7 per cent less than two years ago.

Total sales in the first seven months of the current fiscal year, from July through January, were moderately larger than in the corresponding period of 1938-39 and were also very slightly larger than two years ago. Total tonnage was, in fact, the largest for any corresponding period since the data became available.

With seven of the twelve Southern States reporting smaller January sales than a year earlier, the area as a whole registered a 13 per cent decline. The greatest tonnage declines were in the Carolinas. Mississippi sales were unusually large for the month, and smaller increases occurred in Arkansas, Florida, Texas, and Louisiana.

July-January sales in the South were somewhat smaller than last year but with that exception were the largest for the period in many years. Declines from last year were marked in the Carolinas and Georgia while they were smaller in Virginia, Tennessee, and Texas. These declines more than offset the increases in the other six States.

The outstanding development in the midwestern region was the abnormally large increase in sales in Indiana. Sales in the State usually amount to only a few thousand tons in January and then rise sharply in February and March. January sales in the other four Midwestern States were rather small with increases over last year in Missouri and Kansas and declines in Illinois and Kentucky.

Total sales in the July-January period in the Midwest were 21 per cent above last year but were somewhat less than two years ago. Kansas was the only one of the five States to report a drop. While sales in Kentucky and Missouri were above last year they were smaller than two years ago.

The position of dyes and dyestuffs in Great Britain may be inferred from an announcement made by the Controller of Dyestuffs which stated that the requirements of the Royal Navy, Army, and Air Forces, together with the Auxiliary Forces for Home Defence, have resulted in very large and abnormal demands for dyed wool and cotton textiles. The British dyestuff manufacturers are making every effort to increase their output and have made extraordinary progress, but they are faced with two main difficulties: 1. Many of their fundamental raw products are required also for war purposes; 2. Delivery of new plant for extensions cannot be obtained at a normal rate owing to armament requirements.

There is a definite world shortage of certain foreign dyestuffs, and while continuous efforts are being made to increase our imports from Allied and neutral countries, it must be borne in mind that valuable foreign exchange has to be utilized for their purchase.

The Controller of Dyestuffs wishes to inform color users that licenses to acquire dyestuffs not made in that country will only be granted on the condition that such dyestuffs are reserved, as far as practicable, for the Services and export trade. It will be necessary for users to preserve evidence of the actual use made of these dyestuffs to be available if proof is at any time required for a government check.

The dyestuffs position in Great Britain is immeasurably superior to-day to that in 1914, but the possibility of a shortage of dyestuffs for home trade requirements must be envisaged. It is consequently, necessary for the home trade to plan its colored merchandise requirements so that the consumption of the available dyestuffs may be spread over as large a weight of merchandise as is practicable.

CHEM. & MET.

Weighted Index of

CHEMICAL PRICES

Base = 100 for 1937

This month	**98.96**
Last month	98.72
February, 1939	98.27
February, 1938	101.04

Many chemicals are bringing premiums in the spot market but large deliveries are being made at unchanged prices. Solvents are firm and sharp advances have taken place in turpentine trading. Copper sulphate has sold at reduced levels.

CHEM. & MET.

Weighted Index of Prices for

OILS AND FATS

Base = 100 for 1937

This month	**82.40**
Last month	82.59
February, 1939	67.71
February, 1938	79.79

Most of the vegetable oils were lower during the month but declines were of moderate proportions. Castor oil is in a strong position with difficulty in securing shipments of seed. Animal fats also were a little easier in price tone.

Present Day Chemical Processing

DEMANDS MODERN RESPIRATORY PROTECTIVE EQUIPMENT

1 **M·S·A ONE-HOUR OXYGEN BREATHING APPARATUS**

Safeguards the wearer with a full hour's supply of pure air when work must be conducted or repairs effected in oxygen-deficient atmospheres—even under great physical stress and exertion. The apparatus is compact, well-balanced, light in weight and permits unhampered freedom of action. U. S. Bureau of Mines-approved.

2 **M·S·A COMBINATION HOSE MASK**

Supplies fresh outside air to men working in gas-contaminated or oxygen-deficient confined areas. All-Vision facepiece assures comfortable gas-tight fit on any face, and provides maximum wide-angled vision. U. S. Bureau of Mines-approved, with double inhalation tubes, tested safety belt harness, and choice of hand, motor or motor-hand operated blowers.

3 **M·S·A ALL-SERVICE GAS MASK**

Provides thorough protection against all poisonous gases, fumes and smoke—including carbon monoxide—encountered in air, wherever sufficient oxygen is present to support life . . . and is the *only* canister-type mask so approved by the U. S. Bureau of Mines. New All-Vision facepiece, light-weight wearing comfort and speed of application are outstanding popularity features.

Descriptive bulletins and demonstrations gladly provided on request

MINE SAFETY APPLIANCES COMPANY

Braddock, Thomas & Meade Streets · Pittsburgh, Pa.

District Representatives in Principal Cities

Current PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.07½–$0.07½	$0.07½–$0.07½	$0.05½–$0.06¼
Acid, acetic, 28%, bbl., cwt.	2.23 – 2.48	2.23 – 2.48	2.23 – 2.48
Glacial 99%, drums.	8.43 – 8.68	8.43 – 8.68	8.43 – 8.68
U. S. P. reagent.	10.25 –10.50	10.25 –10.50	10.25 –10.50
Boric, bbl., ton.	106.00–111.00	106.00–111.00	106.00–111.00
Citric, kegs, lb.	.20 – .23	.20 – .23	.22½– .25
Formic, bbl., ton	.10½– .11	.10½– .11	.10½– .11
Gallic, tech., bbl., lb.	.70 – .75	.70 – .75	.70 – .75
Hydrofluoric 30% carb., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Lactic, 44%, tech., light, bbl., lb.	.06½– .06¾	.06½– .06¾	.06½– .06¾
Muriatic, 18°, tanks, cwt.	1.05 –	1.05 –	1.05 –
Nitric, 36°, carboys, lb.	.05 – .05½	.05 – .05¼	.05 – .05¼
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –	18.50 –20.00
Oxalic, crystals, bbl., lb.	.10½– .12	.10½– .12	.10½– .12
Phosphoric, tech., c'bys., lb.	.07½– .08½	.07½– .08½	.07½– .08½
Sulphuric, 60°, tanks, ton	13.00 –	13.00 –	13.00 –
Sulphuric, 66°, tanks, ton	16.50 –	16.50 –	16.50 –
Tannic, tech., bbl., lb.	.44 – .45	.40 – .45	.40 – .45
Tartaric, powd., bbl., lb.	.35½–	.31½–	.27½–
Tungstic, bbl., lb.	nom.	nom.	2.75 –
Alcohol, amyl	–	–	–
From Pentane, tanks, lb.	.10½–	.10½–	.10½–
Alcohol, Butyl, tanks, lb.	.09 –	.09 –	.08 –
Alcohol, Ethyl, 190 p'f., bbl., gal.	4.54 –	4.54 –	4.54 –
Denatured, 190 proof	–	–	–
No. 1 special, bbl., gal. wks.	.29½–	.29½–	.28 –
Alum, ammonia, lump, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Potash, lump, bbl., lb.	.03¾– .04	.03¾– .04	.03¾– .04
Aluminum sulphate, com. bags, cwt.	1.15 – 1.40	1.15 – 1.40	1.15 – 1.40
Iron free, bg., cwt.	1.30 – 1.55	1.30 – 1.55	1.30 – 1.55
Aqua ammonia, 26°, drums, lb.	.02½– .03	.02½– .03	.02 – .03
tanks, lb.	.02 – .02½	.02 – .02½	.02 – .02½
Ammonia, anhydrous, cyl., lb.	.16 –	.16 –	.15½– .16
tanks, lb.	.04½–	.04½–	.04½– .16
Ammonium carbonate, powd. tech., casks, lb.	.09 – .12	.09 – .12	.08 – .12
Sulphate, wks., cwt.	1.40 –	1.40 –	1.40 –
Amylacetate tech., tanks, lb.	.11½–	.10½–	.09½–
Antimony Oxide, bbl., lb.	nom.	nom.	.11 – .12
Arsenic, white, powd., bbl., lb.	.03 – .03¼	.03 – .03¼	.03 – .03½
Red, powd., kegs, lb.	.15½– .16	.15½– .16	.15½– .16
Barium carbonate, bbl., ton	52.50 –57.50	52.50 –57.50	52.50 –57.50
Chloride, bbl., ton.	79.00 –81.00	79.00 –81.00	79.00 –81.00
Nitrate, casks, lb.	.07 – .08	.07 – .08	.07 – .08
Blanc fixe, dry, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f. o. b., wks., drums, cwt.	2.00 – 2.10	2.00 – 2.10	2.00 – 2.10
Borax, gran., bags, ton.	48.00 –51.00	48.00 –51.00	48.00 –51.00
Bromine, cs., lb.	.30 – .32	.30 – .32	.30 – .32
Calcium acetate, bags.	1.90 –	1.90 –	1.65 – 1.75
Arsenate, dr., lb.	.06½– .07	.06½– .07	.06½– .07
Carbide drums, lb.	.04½– .05	.04½– .05	.05 – .06
Chloride, fused, dr., del., ton	21.50 –24.50	21.50 –24.50	21.50 –24.50
flake, dr., del., ton	23.00 –25.00	23.00 –25.00	23.00 –25.00
Phosphate, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb.	.05 – .06	.05 – .06	.05 – .06
Tetrachloride drums, lb.	.04½– .05½	.04½– .05½	.04½– .05½
Chlorine, liquid, tanks, wks., lb.	1.75 –	1.75 –	2.00 –
Cylinders.	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb.	1.84 – 1.87	1.84 – 1.87	1.67 – 1.70
Copperas, bgs., f. o. b., wks., ton	17.00 –18.00	17.00 –18.00	15.00 –16.00
Copper carbonate, bbl., lb.	.10 – .16½	.10 – .16½	.10 – .16
Sulphate, bbl., cwt.	4.75 – 5.00	4.75 – 5.00	4.50 – 4.75
Cream of tartar, bbl., lb.	.28½–	.25½–	.22½–
Diethylene glycol, dr., lb.	.22 – .23	.22 – .23	.22 – .23
Epsom salt, dom., tech., bbl., cwt.	1.80 – 2.00	1.80 – 2.00	1.80 – 2.00
Ethyl acetate, drums, lb.	.06½–	.06½–	.06½–
Formaldehyde, 40%, bbl., lb.	.05½– .06¼	.05½– .06¼	.05½– .06¼
Furfural, tanks, lb.	.09 –	.09 –	.09 –
Fusel oil, ref. drums, lb.	.16 – .17	.16 – .17	.12½– .14
Glaubers salt, bags, cwt.	.95 – 1.00	.95 – 1.00	.95 – 1.00
Glycerine, c.p., drums, extra, lb.	.12½–	.12½–	.12½–
Lead:			
White, basic carbonate, dry casks, lb.	.07 –	.07 –	.07 –
White, basic sulphate, sck., lb.	.06½–	.06½–	.06½–
Red, dry, sck., lb.	.07½–	.08 –	.0735–
Lead acetate, white crys., bbl., lb.	.11 – .12	.11 – .12	.10 – .11
Lead arsenate, powd., bbl., lb.	.10 – .10½	.10 – .10½	.11 – .11½
Lime, chem., bulk, ton	8.50 –	8.50 –	8.50 –
Litharge, pwd., csk., lb.	.06½–	.07 –	.0635–
Lithophone, bags, lb.	.036– .04	.036– .04	.04½– .05
Magnesium carb., tech., bags, lb.	.06¼– .06½	.06¼– .06½	.06 – .06¼

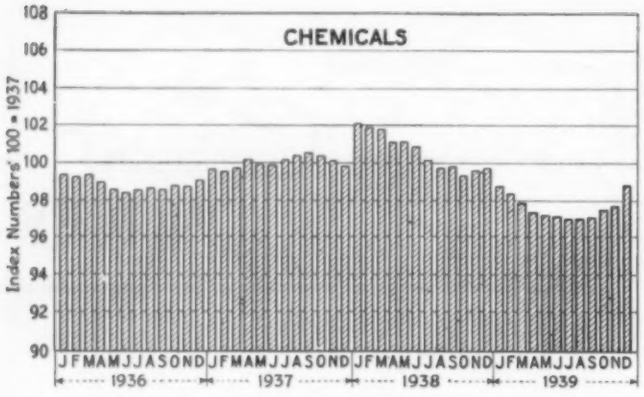
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Feb. 15

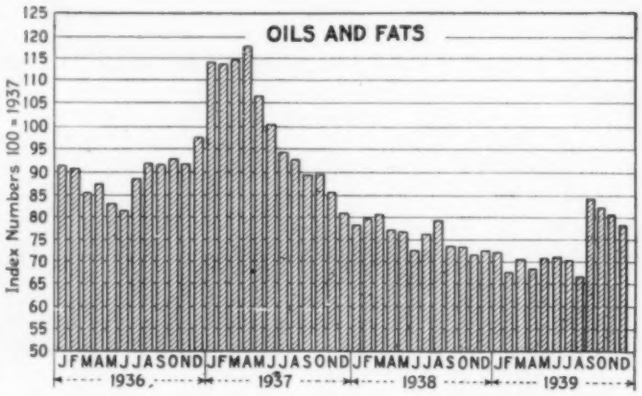
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal.	.31 –	.31 –	.31 –
97%, tanks, gal.	.32 –	.32 –	.32 –
Synthetic, tanks, gal.	.33 –	.33 –	.33 –
Nickel salt, double, bbl., lb.	.13 – .13½	.13 – .13½	.13 – .13½
Orange mineral, csk., lb.	.10¼–	.10¼–	.10¼–
Phosphorus, red, cases, lb.	.40 – .42	.40 – .42	.40 – .42
Yellow, cases, lb.	.18 – .25	.18 – .25	.18 – .25
Potassium bichromate, casks, lb	.08¼– .09	.08¼– .09	.08⅝– .09
Carbonate, 80–85%, calc. csk., lb.	.06½– .07	.06½– .07	.06½– .07
Chlorate, powd., lb.	.10 – .12	.10 – .12	.09½–
Hydroxide(c'stic potash) dr., lb.	.07 – .07¼	.07 – .07¼	.07 – .07¼
Muriate, 80% bgs., unit.	.53½–	.53½–	.53½–
Nitrate, bbl., lb	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb.	.18½– .19	.18½– .19	.18½– .19
Prussiate, yellow, casks, lb	.15 – .16	.15 – .16	.14 – .15
Sal ammoniac, white, casks, lb.	.05½– .06	.05½– .06	.05 – .05½
Salsoda, bbl., cwt.	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	23.00 –	23.00 –	13.00 –15.00
Soda ash, light, 58%, bags, contract, cwt.	1.05 –	1.05 –	1.05 –
Dense, bags, cwt.	1.10 –	1.10 –	1.10 –
Soda, caustic, 76%, solid, drums, cwt.	2.30 – 3.00	2.30 – 3.00	2.30 – 3.00
Acetate, works, bbl., lb.	.04 – .05	.04 – .05	.04 – .05
Bicarbonate, bbl., cwt.	1.70 – 2.00	1.70 – 2.00	1.70 – 2.00
Bichromate, casks, lb.	.06½– .07	.06½– .07	.06½– .07
Bisulphate, bulk, ton	15.00 –16.00	15.00 –16.00	15.00 –16.00
Bisulphite, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Chlorate, kegs, lb.	.06½– .06¾	.06½– .06¾	.06½– .06¾
Cyanide, cases, dom., lb.	.14 – .15	.14 – .15	.14 – .15
Fluoride, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Hyposulphite, bbl., cwt.	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt.	2.35 – 2.40	2.20 – 3.20	2.20 – 3.20
Nitrate, bulk, cwt.	1.45 –	1.45 –	1.45 –
Nitrite, casks, lb.	.06¾– .07	.06¾– .07	.06¾– .07
Phosphate, tribasic, bags, lb.	2.25 –	2.25 –	1.85 –
Prussiate, yel. drums, lb.	.10½– .11	.10½– .11	.09½– .10
Silicate (40° dr.) wks., cwt.	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr., lb.	.02¾– .03¼	.02¾– .03	.02¾– .03
Sulphite, crys., bbl., lb.	.02¼– .02½	.02½– .02¼	.02¼– .02½
Sulphur, crude at mine, bulk, ton	16.00 –	16.00 –	18.00 –
Chloride, dr., lb.	.03 – .04	.03 – .04	.03 – .04
Dioxide, cyl., lb.	.07 – .08	.07 – .08	.07 – .07½
Flour, bag, cwt.	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl., lb.	.52 –	.52 –	.50 –
Crystals, bbl., lb.	.36 –	.37 –	.35½–
Zinc, chloride, gran., bbl., lb.	.05 – .06	.05 – .06	.05 – .06
Carbonate, bbl., lb	.14 – .15	.14 – .15	.14 – .15
Cyanide, dr., lb.	.33 – .35	.33 – .35	.33 – .35
Dust, bbl., lb.	.07½–	.08½–	.06½–
Zinc oxide, lead free, bag., lb.	.06½–	.06½–	.06½–
5% lead sulphate, bags, lb.	.06½–	.06½–	.06½–
Sulphate, bbl., cwt.	2.75 – 3.00	2.75 – 3.00	2.75 – 3.00

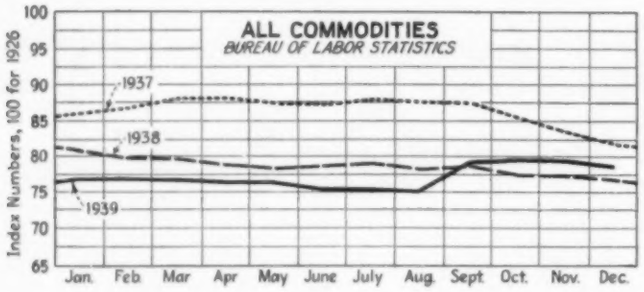
OILS AND FATS

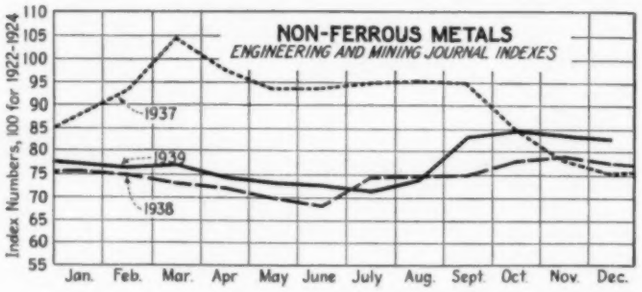
	Current Price	Last Month	Last Year
Castor oil, 3 bbl., lb.	$0.11½–$0.12	$0.11½–$0.12	$0.09½–$0.10
Chinawood oil, bbl., lb.	.27 –	.27 –	.14½–
Coconut oil, Ceylon, tank, N. Y., lb.	.03¾–	.03½–	.03 –
Corn oil crude, tanks (f. o. b. mill), lb.	.06 –	.06 –	.05½–
Cottonseed oil, crude (f. o. b. mill), tanks, lb.	.06 –	.05½–	.05½–
Linseed oil, raw car lots, bbl., lb.	.103–	.108–	.085–
Palm, casks, lb.	.05½–	.05½–	.03½–
Peanut oil, crude, tanks (mill), lb.	.06½–	.06¼–	.05½–
Rapeseed oil, refined, bbl., gal.	1.00 –	1.00 –	.80 –
Soya bean, tank, lb.	.05¼–	.05½–	.04½–
Sulphur (olive foots), bbl., lb.	.08 –	.08½–	.07 –
Cod, Newfoundland, bbl., gal.	nom.	nom.	.38 –
Menhaden, light pressed, bbl., lb.	.075–	.073–	.07 –
Crude, tanks (f. o. b. factory), gal.	.36 –	.36 –	.30 –
Grease, yellow, loose, lb.	.05 –	.05 –	.04½–
Oleo stearine, lb.	.06½–	.06½–	.06½–
Oleo oil, No. 1	.07¼–	.07¼–	.07½–
Red oil, distilled, d.p. bbl., lb.	.09 –	.09 –	.07½–
Tallow extra, loose, lb.	.05¼–	.05¼–	.05½–

Chem. & Met.'s Weighted Price Indexes









COAL-TAR PRODUCTS

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb	$0.52 –$0.55	$0.52 –$0.55	$0.52 –$0.55
Alpha-naphthylamine, bbl., lb	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb	.15 – .16	.15 – .16	.15 – .16
Aniline, salts, bbl., lb	.22 – .24	.22 – .24	.22 – .24
Benzaldehyde, U.S.P., dr., lb	.85 – .95	.85 – .95	.85 – .95
Benzidine base, bbl., lb	.70 – .75	.70 – .75	.70 – .75
Benzoic acid, U.S.P., kgs., lb	.54 – .56	.54 – .56	.54 – .56
Benzyl chloride, tech., dr., lb	.23 – .25	.23 – .25	.23 – .25
Benzol, 90%, tanks, works, gal	.16 –	.16 – .18	.16 – .18
Beta-napthol, tech., drums, lb	.23 – .24	.23 – .24	.23 – .24
Cresol, U.S.P., dr., lb	.09½– .10	.09½– .10	.10 – .11
Cresylic acid, dr., wks., gal	.58 – .60	.58 – .60	.69 – .71
Diethylaniline, dr., lb	.40 – .45	.40 – .45	.40 – .45
Dinitrophenol, bbl., lb	.23 – .25	.23 – .25	.23 – .25
Dinitrotoluen, bbl., lb	.15½– .16	.15½– .16	.15 – .16
Dip oil, 15%, dr., gal	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, bbl., lb	.32 – .36	.32 – .36	.32 – .36
H-acid, bbl., lb	.50 – .55	.50 – .55	.50 – .55
Naphthalene, flake, bbl., lb	.06½– .07	.06½– .07	.05½– .06
Nitrobenzene, dr., lb	.08 – .09	.08 – .09	.08 – .09
Para-nitraniline, bbl., lb	.47 – .49	.47 – .49	.47 – .49
Phenol, U.S.P., drums, lb	.13 –	.13 –	.14½–
Picric acid, bbl., lb	.35 – .40	.35 – .40	.35 – .40
Pyridine, dr., gal	1.70 – 1.80	1.70 – 1.80	1.55 – 1.60
Resorcinal, tech., kegs, lb	.75 – .80	.75 – .80	.75 – .80
Salicylic acid, tech., bbl., lb	.33 – .40	.33 – .40	.33 – .40
Solvent naptha, w.w., tanks, gal	.27 –	.27 –	.26 –
Tolidine, bbl., lb	.86 – .88	.86 – .88	.86 – .88
Toluene, drums, works, gal	.30 –	.30 –	.27 –
Xylene, com, tanks, gal	.27 –	.27 –	.26 –

MISCELLANEOUS

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech., bbl., lb	.10½– .14	.13 – .17	.08½– .11
China clay, dom., f.o.b. mine, ton	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors			
Carbon gas, black (wks.), lb	.02½– .30	.02½– .30	.02½– .30
Prussian blue, bbl., lb	.36 – .37	.36 – .37	.36 – .37
Ultramarine blue, bbl., lb	.11 – .26	.11 – .26	.10 – .26
Chrome green, bbl., lb	.21½– .30	.21½– .30	.21 – .27
Carmine red, tins, lb	4.85 – 5.00	4.85 – 5.00	4.00 – 4.40
Para toner, lb	.75 – .80	.75 – .80	.75 – .80
Vermilion, English, bbl., lb	2.45 – 2.60	2.45 – 2.60	1.56 – 1.60
Chrome yellow, C.P., bbl., lb	.14½– .15½	.14½– .15½	.14½– .15½
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb	.06 – .06½	.06 – .06½	.06 – .06½
Gum copal Congo, bags, lb	.08 – .30	.08 – .30	.06 – .30
Manila, bags, lb	.09 – .15	.09 – .14	.09 – .14
Damar, Batavia, cases, lb	.10 – .22	.10 – .20	.08 – .24
Kauri, cases, lb	.18 – .60	.18 – .60	.18½– .60
Kieselguhr (f.o.b. N.Y.), ton	50.00 –55.00	50.00 –55.00	50.00 –55.00
Magnesite, calc, ton	50.00 –	50.00 –	50.00 –
Pumice stone, lump, bbl., lb	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb	.03 – .04	.03 – .04	.03 – .04
Rosin, H., bbl	6.80 –	6.75 –	6.50 –
Turpentine, gal	.41 –	.34½–	.30½–
Shellac, orange, fine, bags, lb	.28 –	.32 –	.20 –
Bleached, bonedry, bags, lb	.25 –	.25 –	.19 –
T. N. Bags, lb	.19 –	.19 –	.10½–
Soapstone (f.o.b. Vt.), bags, ton	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc. 200 mesh (f.o.b. Vt.), ton	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
300 mesh (f.o.b. Ga.), ton	7.50 –10.00	7.50 –10.00	7.50 –11.00
225 mesh (f.o.b. N.Y.), ton	13.75 –	13.75 –	13.75 –

INDUSTRIAL NOTES

AMERICAN CHAIN & CABLE CO. INC., New York, has appointed C. N. Johns to succeed C. G. Williams in charge of operations. George C. Moon has been appointed general manager of sales and William D. Kirkpatrick who has been general manager of sales of the American Chain Division has been elected a vice-president of the company.

THE BABCOCK & WILCOX TUBE CO., Beaver Falls, Pa., announces that W. W. Williams former manager has resigned from the company due to ill health.

AMERICAN MACHINE AND METALS, INC., East Moline, Ill., has appointed Franklin H. Fowler assistant to the president and executive head of operations of the Tolhurst Centrifugal Division.

DETROIT REX PRODUCTS CO., Detroit, has promoted H. R. Norgen to assistant sales manager, D. E. Williard to assistant sales manager of branch offices, and R. A. O'Reilly to manager of the dry cleaning division.

THE MULLITE REFRACTORIES CO., Shelton, Conn., is now represented in the midwest territory by F. M. Ruggles with headquarters in Chicago.

SHARPLES SPECIALTY CO., Philadelphia, has appointed G. J. Keady to the position of executive vice-president.

AMERICAN ELECTRO METAL CORP., Lewiston, Maine, is equipping a research laboratory for powder metallurgy. It will provide departments for powder manufacture, milling, pressing, sintering, as well as mechanical, chemical, metallographical, spectrographical, and X-ray testing.

THE NEVILLE CO., Pittsburgh, has announced that it is marketing a group of new, naphthalene-free, refined high boiling coal-tar solvents.

ANGLO-FRENCH PURCHASING BOARD, New York, newly created purchasing organization of Great Britain and France, is now established at 15 Broad St. Arthur B. Purvis and J. Frederick Bloch-Lane head the board. An office in the Hibbs Bldg., Washington has been opened with Charles T. Ballantyne in charge.

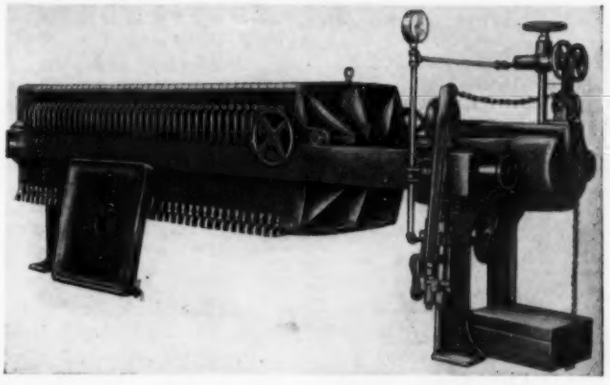
JOHN A. ROEBLING'S SONS CO., Trenton, N. J., announces that Chas. G. Williams has been appointed general manager and that Edward D. Emerson has joined the company in the capacity of general manager of sales.

THE AUTOMATIC GAS-STEAM RADIATOR CO., Pittsburgh, has changed its name to the Automatic Gas Equipment Co. There has been no change in personnel.

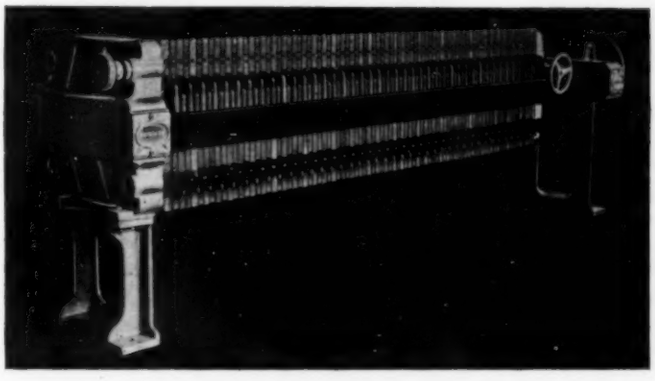
CHEMICAL MARKETING CO., INC., New York, has moved its offices to 10 East 40th St. The company plans to produce a new synthetic organic chemical known as "Lamepon."

What Can a Shriver Filter Press Do?

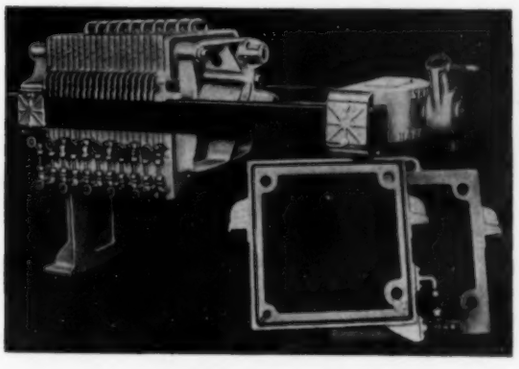
You know, of course, the primary job of a filter is to recover solids or liquids from a fluid mixture. Other types of filters, with varying degrees of success, can do as much. But have you ever considered the wide field the filter press covers successfully not only among the materials difficult to filter, but the variety of processing factors it can tie together under difficult physical conditions to effect definite savings in production and equipment cost? Take these few examples:



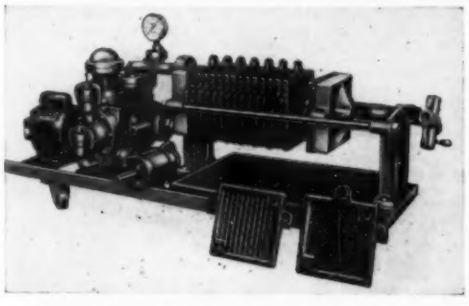
Filtering Pigments—A 40 chamber filter press, center feed, open delivery for 100 lb. pressure; equipped with hydraulic closing device.



Filtering Strong Phosphoric Acid—A 42 chamber filter press with semi-hard rubber plates and frames, corner feed, open delivery.



Filtering Hot Alkaline Resin—using filter aid. A corner feed, closed delivery filter press with visible discharge and leakproof plates and frames for hot filtration and washing of filter cake.



Filtering Acid Copper Sulphate—Experimental filter press unit with rubber covered metal plates and frames and rubber covered Shriver Diaphragm Pump.

There are many other Shriver Filter Press types in any size and material of construction to meet your exact needs. Write for our catalog and complete data.

T. SHRIVER & COMPANY
802 Hamilton St. Harrison, N. J.

Western Representatives—The Merrill Co.
343 Sansome St. San Francisco, Calif.

FOR BETTER FILTRATION

Shriver FILTER PRESSES

New CONSTRUCTION

	Current Projects		Cumulative 1940	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	.....	.....	.....	$40,000
Middle Atlantic	$2,310,000	$367,000	$4,385,000	542,000
South	2,000,000	4,000,000	4,530,000	1,640,000
Middle West	3,195,000	650,000	3,935,000	500,000
West of Mississippi	440,000	9,150,000	5,355,000	208,000
Far West	830,000	1,665,000	830,000	3,120,000
Canada	835,000	510,000	1,205,000	510,000
Total	$9,610,000	$16,342,000	$20,240,000	$6,560,000

PROPOSED WORK

Alkali Plant—Southern Alkali Corp., 30 Rockefeller Plaza, New York, N. Y., contemplates no $13,000,000 addition to its plant at Corpus Christi, Tex. This corrects report appearing in January.

Carbon Factory—Great Lakes Carbon Co., 8700 Kinsman Ave., Cleveland, O., contemplates the construction of a plant at Long Beach, Calif. Estimated cost will exceed $40,000.

Chemical Plant — First Texas Chemical Manufacturing Co., 1810 North Lamon St., Dallas, Tex., plans to build a 2 story addition to its plant.

Corrugated Paper Factory—Dominion Corrugated Paper Co., Ltd., 142 Weston Rd., Toronto, Ont., Can., plans to rebuild its plant on Junction Rd. $50,000.

Creosoting Plant—Canadian Creosoting Co., Ltd., L. L. Brown, Pres., 606 Cathcart St., Montreal, Que., Can., is negotiating for a site at Port Arthur, Ont., for a plant. $150,000.

Distillery—Frankfort Distilleries, 1300 Race St., Baltimore, Md., contemplates the construction of a bottling house at its distillery.

Distillery—Melchers Distilleries, Ltd., 427 St. James St., W., Montreal, Que., Can., plans alterations and additions to its distillery at Berthienville, Que. Bids will soon be received by C. David, Archt., 1440 St. Catherines St., W., Montreal. $30,000.

Factory—Air Reduction Sales Co., 60 East 42nd St., New York, N. Y., will soon award the contract for a factory at Berkeley, Calif. Estimated cost will exceed $40,000.

Factory—Liquid Carbonic Co., Hemphill and Center Sts., Houston, Tex., plans to construct a manufacturing plant. $100,000.

Fertilizer Factory—Ohio Farm Bureau, J. E. Keltner, Treas., Farm Bureau Bldg., Columbus, O., plans to construct a factory and warehouse on Leonard Ave. near Taylor Ave., Columbus. $150,000.

Gas Pipe Lines—Michigan Consolidated Gas Co., 415 Clifford St., Detroit, Mich., plans to construct 80 mi. 22 in. steel gas pipe line in Detroit district, including high pressure lines. Estimated cost $3,000,000.

Gypsum Factory—National Gypsum Co., Delaware Ave., Buffalo, N. Y., plans to build an addition to its plant on Cabot St., New York, N. Y., also a warehouse. Estimated cost $90,000.

Insecticide Plant — Insecticide Corp. of America, East Center St., Medina, N. Y., plans to build an addition to its plant. Estimated cost including equipment will exceed $40,000.

Insulation Board Factory—Flintkote Co., 50 West 50th St., New York, N. Y., has acquired a 250 acre site adjacent to the city of Meridian, Miss., and plans to construct 300x1200 ft. factory. Estimated cost including equipment $2,000,000.

Paper Mill—Transcontinental Paper Co., Ltd., 25 King St., W., Toronto, Ont., Can., has purchased a site at Kapuskasing, Ont., and plans to construct a pulp and paper mill. Estimated cost $500,000.

Pigment Plant—Northern Pigment Co., Ltd., New Toronto, Ont., Can., plans to build an addition to its plant in the Spring. $40,000.

Recycling Plant—American Liberty Oil Co., Crockett and Grapeland, Tex., plans to construct a recycling plant at Grapeland. $150,000.

Refinery—Sinclair Refining Co., Wichita Falls, Tex., plans to improve and install new equipment in Station Plant, KMA plant north of Kadene and new plant in north part of Hull and Silk Pool, Archer Co. $150,000.

Rubber Factory—Barr Rubber Products Co., Sandusky, O., will soon receive bids for two additional factory units. Estimated cost between $40,000 and $50,000.

Salt Factory—Pennsylvania Salt Mfg. Co., 100 Widener Bldg., Philadelphia, Pa., has acquired a 50 acre tract of the Delaware River at Cornwells Heights and plans to construct a factory. Estimated cost $2,000,000.

Salt Factory—Pennsylvania Salt Mfg. Co., 100 Widener Bldg., Philadelphia, Pa., plans to construct a new plant on the Washington Tide Flats at Tacoma, Wash., in addition to plant already in operation. Estimated cost $750,000.

Soap Factory—Colgate-Palmolive-Peet Co., 105 Hudson St., Jersey City, N. J., plans alterations and addition to its factory on Hudson St. H. K. Ferguson Co., 1650 Hanna Bldg., Cleveland, O., Engrs.

Warehouse—Irving Oil, Ltd., 17 Dock St., St. John, N. B., Can., plans to construct a warehouse and bulk storage plant at Bathurst, N. B. $65,000.

Wood Preserving Plant—Keystone Wood Preserving Co., Waterford, N. Y., and Porter and Weccacoe Ave., Philadelphia, Pa., plans to construct a wood preserving plant at Waterford. $100,000.

CONTRACTS AWARDED

Catalytic Gasoline Plant—Mid Continent Petroleum Corp., Cosden Bldg., Tulsa, Okla., has awarded the contract for a catalytic gasoline manufacturing plant to M. W. Kellogg Co., 225 Bway., New York, N. Y. Estimated cost $2,500,000.

Carborundum Factory — Canadian Carborundum Co., Ltd., Niagara Falls, Ont., Can., has awarded general contract for addition to plant on Stanley St., to R. Timms Construction Co., Ltd., 221 Burgar St., Welland, Ont. $40,000.

Distillery—A. Overholt & Co., Inc., 120 Bway., New York, N. Y., has awarded the contract for 2 story distillery at Connellsville, Pa., to Sanderson & Porter, 52 William St., New York, N. Y. Estimated cost $200,000.

Factory—Canadian Industries, Ltd., 1135 Beaver Hall Hill, Montreal, Que., Can., manufacturer of paints, varnishes, etc., will build extensions to its plant on Ottawa St., Hamilton, Ont. Work will be done by day labor under supervision of owner. $200,000.

Factory—General Aniline Works, Inc., 435 Hudson St., New York, N. Y., has awarded contract for 2 story addition to plant at Grasselli, N. J., to White Construction Co., 95 Madison Ave., New York, N. Y.

Gas Manufacturing Plant—Pure Oil Co., Van (Van Zandt Co.), Tex., plans to enlarge its Butane gas manufacturing plant at Van. Work will be done by force account. $45,000.

Grinding Mill—Alpha Portland Cement Co., Jamesville, N. Y., has awarded the general contract for 45x60x80 ft. grinding mill to W. J. Burns Construction Co., Heffernan Bldg., Syracuse. $40,000.

Oil Pipe Line—Inland Empire Refineries, Inc., Hillyard St., Spokane, Wash., has awarded the contract for 320 mi. 6 in. oil pipe line from Cut Bank, Mont., to Spokane, Wash., including two pumping stations, one near Cut Bank and other near Kalispell, Mont., to Williams Bros., National Bank of Tulsa Bldg., Tulsa, Okla., and W. A. Bechtel Co., 155 Sansome St., San Francisco, Calif. Estimated cost $3,000,000.

Oil Pipe Line—Shell Oil Co., Shell Bldg., St. Louis, Mo., has awarded contract for about 9 mi. 8 in. and 2 mi. 6 in. seamless line from company's oil and gas leases in Salem oil field to Sandoval, to connect with Illinois Pipe Line System, to I. C. Little, Salem; pipe to National Tube Co., 506 Olive St., St. Louis. Estimated cost $150,000.

Oil Refinery—Continental Oil Co., D. Moran, Pres., Ponca City, Okla., will construct new refinery at Lake Charles, La., to have capacity of 8,000 bbl. gasoline per day. Work will be done by company labor. Estimated cost $4,000,000.

Paint Factory—Davis Irwin Ltd., 20 Bates Rd., Mount Royal, Que., Can., manufacturer of dry colors and paints, has awarded the contract for an addition to its plant to Corinthian Construction Co., Ltd., 5726 Sherbrooke St., W., Montreal. Estimated cost $35,000.

Paper Mill—H. P. Smith Paper Co., 1129 West 37th St., Chicago, Ill., has awarded contract for paper mill at West 66th St. and LaVergne Ave., Chicago, to Clearing Industrial District, 6455 Central Ave., Chicago. Estimated cost $150,000.

Paper Mill—Tennessee Valley Paper Mills, Inc., Knoxville and Huntington, Tenn., has awarded contract for paper mill in Hardin Co., near Savannah, Tenn., to Merritt-Chapman & Scott, 17 Battery Pl., New York, N. Y. Total est. $5,000,000.

Polish Manufacturing Plant—Beaver Products Co., Ltd., 4519 Papineau Ave., Montreal, Que., Can., has awarded the contract for a plant at St. Laurent, Que., to J. L. Guay & Bro., Ltd., 87 Notre Dame St., W., Montreal. Estimated cost $35,000.

Roofing Factory—Barrett Co., Ltd., 5551 St. Hubert St., Montreal, Que., Can., will alter and build additions to its factory on Artemise St., Jollette, Que. Work will be done by day labor under supervision of owner. $200,000.

Roofing Factory—Lloyd A. Fry Roofing Co., 1501 North Tamarind St., Compton, Calif., has awarded the contract for a factory to Myers Bros., 3407 San Fernando Rd., Los Angeles. Estimated cost $80,000.

Soap Factory—Colgate-Palmolive-Peet Co., 105 Hudson St., Jersey City, N. J., has awarded the contract for reinforced concrete silo on Sussex St., to Nicholson Co., 405 Lexington Ave., New York, N. Y., at $27,000; conveyor bridge from Grand to Hudson Sts., to Schaefer Iron Works, 268 River Rd., Edgewater, N. J., at $20,000.

Warehouse—Glenshaw Glass Co., Glenshaw, Pa., has awarded the contract for a warehouse to Pittsburgh Industrial Engineering Co., 3939 Butler St., Pittsburgh.

Warehouse—Humble Oil & Refining Co., Humble Bldg., Houston, Tex., has awarded the contract for warehouse and service station to Rable Wilson, 6643 Navigation Bldg., Houston. $40,000.

Warehouse — National Distillers Products Corp., Section Rd. and Anthony Wayne Ave., Cincinnati, O., has awarded the contract for 48,000 bbl. capacity warehouse to Frank Messer & Sons, Inc., 2515 Burnet St., Cincinnati. Estimated cost $500,000.